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A COMPILATION OF SEDIMENT SURVEY REPORT SERIES ABSTRACTS TO 1987

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A COMPILATION OF SEDIMENT SURVEY REPORT SERIES ABSTRACTS TO 1987

Compiled

by

MORLEY A. CASHMAN

Sediment Survey Section
Water Survey of Canada
Water Resources Branch
Environment Canada, 1988

IWD-HQ-WRB-SS-88-1

PREFACE

This document presents a compilation of abstracts or summaries from fifty four publications from the Water Resources Branch, Sediment Survey report series from 1984 to 1987. Included also are two unnumbered reports published in 1974 by R. Kellerhals, et al., and 1983 by T.R. Yuzyk.

Abstracts or summaries are copied directly from the reference reports and are organized in sequential order by Series Number.

Inside the front cover is a brief explanation of the Report Series Number.

PREFACE

Le présent document présente une compilation de résumés de 54 publications parues entre 1984 et 1987 dans la série des rapports sur l'étude des sédiments de la Direction des ressources en eau. En font également partie deux rapports non numérotés publies en 1974 par R. Kellerhals et coll. et en 1983 par T.R. Yuzyk.

Les résumés sont copiés directement du rapport cité et sont classés par numéro de série.

Une courte explication du numéro de série des rapports figure à l'intérieur de la page couverture.

ABSTRACT

Since 1984 the Sediment Survey Section of the Water Resources Branch, Environment Canada has published sediment related reports covering a wide range of topics in a "Sediment Survey Program Report Series". Some of the topics of these reports are: Sediment Issues, Studies, Workshops, and Equipment. This document is a collection of the abstracts or introductions from these reports. Two earlier more popular sediment related reports from 1983 and 1974 were reprinted for circulation are included in this book. If an abstract was not available from the report the author included a brief summary of the report.

Copies of the reports referenced in this document are available upon request from:

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INTRODUCTION

This document represents a compilation of abstracts or the introductions from the Water Resources Branch, Environment Canada Sediment Survey report series.

The book is organized as follows:

1. An alphabetical list by author(s) showing the title of the report in the series and the page number location in this book.

2. The report abstracts are presented by Water Resources Branch series number

In addition to the author(s) and title, an abstract or summary is provided. The latter is copied directly from the report or compiled by the author of this book. If the series number is not included the report has not been approved for circulation.

It is the intention of the author to update this book as additional reports are written and published in the Sediment Survey report series.

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CHURCH, M., MILES, M. and ROOD, K.	Sediment Transport along Mackenzie River: A Feasibility Study, 135 p., IWD-WNR(NWT)-WRB-SS-87-1.	34
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CHURCH, M., KELLERHALS, R. and WARD, P.R.	Sediment in the Pacific and Yukon Region: Review and Assessment, 250 p., IWD-HQ-WRB-SS-85-8.	59
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DAY, T.J.	Sediment Surveys: It's Time to Yield, 40 p., IWD-HQ-WRB-SS-86-5.	44
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KELLERHALS, R., ABRAHAMS, A.D. and VON GAZA, H.	Possibilities for Using Suspended Sediment Rating Curves in the Canadian Sediment Survey Program, 136 p., 1974.	80
LAPOINTE, F.	Evaluation de Rendement de Pompes Compatibles a L'Echantillonneur Automatique PWS, 40 p., IWL-HQ-WRB-87-8.	9
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LAPOINTE, F.	Etude de la variabilités des methodes d'échantillonnage des sediments en suspension pour des concentrations inférieures à 50 mg/L, 45 p., IWD-HQ-WRB-SS-85-9.	58
LAPOINTE, F.	Etude de la representativité de l'échantillonneur automatique PWS basée sur les données existantes, 140 p., IWD-HQ-WRB-SS-84-6.	71
LAPOINTE, F.	Methods D'Echantillonnage Des Sédiments en Suspension - Variabilité et Correlation, p., IWL-HQ-WRB-SS-87-7.	10
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McLEAN, D.G. and CHURCH, M.	A Re-Examination of Sediment Transport Observations in the Lower Fraser River, 122 p., IWD-HQ-WRB-SS-86-6.	43
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NORTHWEST HYDRAULIC CONSULTANT LTD.	Assessment of Sediment Issues and Survey Program in the Prairie Provinces, 120 p., IWD-HQ-WRB-SS-85-5.	64
PENNER, F., YUZYK, T.R., OSHOWAY, R.	A Compilation of Manitoba Sediment Data to 1985, 200 p., IWD-WNR(M)-WRB-SS-87-3.	28
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YUZYK, T.R.	Lake Diefenbaker, Saskatchewan: A Case Study of Reservoir Sedimentation, 135 p., 1983.	78

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YUZYK, T.R.	Reservoir Sedimentation Studies in Canada, 35 p., IWD-HQ-WRB-SS-84-1.	77
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ZRYMIAK, P. and CASHMAN, M.A.	Accuracy and Precision in Sediment Surveys: Annotated Bibliography, 77 p., IWD-HQ-WRB-SS-86-4.	45
ZRYMIAK, P., and TASSONE, B.	Sediment Station Analysis: Fraser River at Hansard 08KA004, 200 p., IWD-PYR-WRB-SS-86-1.	56

ABSTRACTS BY REPORT SERIES NUMBER

LAPOINTE, F.
1987: Evaluation de Rendement de Pompes Compatibles a L'Echantillonneur Automatique PWS. IWL-HQ-WRB-SS-87-8.

SUMMARY

This report presents the results of hydraulic test carried out to establish the (head of water)-(discharge) curves for three pump models: Warren Rupp SPA1/2E, Jaccuzi BS4 and Hydromatic SP 50 MH. These pumps were selected by taking into account their compatibility with the automatic suspended sediment sampler, PWS. To complete the evaluation of these pumps, the interpretation of the results were based on constraints on the pumps resulting from the installation characteristics of the PWS (1). The constraints on the pumps are the flow resistance of the hydraulic system of the PWS and the static head between the water level and the manifold system of the sampler.

The results show that the Jaccuzi BS4 is the superior pump because it supplies the most discharge to the BWS. However, for a station that does not have an alternating current (AC) power supply, the Warren-Rupp (a DC pump) is the best choice. The Hydromatic pump SP 50 HM, is not recommended for use with the PWS because the discharge above. The results of laboratory test indicate the SP 50's performance is lower than the company's specifications.

The results also indicate that the PWS must use a sampling nozzle equal to or lower than 13 mm diameter. This will permit the pump to operate at a greater static head between the water level in the stream and the manifold system of the sampler, and ensure an adequate sampling velocity.

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1 "Etude du comportement hydraulique de l'echantillonneur automatique, PWS", Lapointe F, IWB-HQ-SS-86-12, Environment Canada.

LAPOINTE, F.
1987: METHODS D'ECHANTILLONNAGE DES SEDIMENT EN SUSPENSION - VARIABILITE ET CORRELATION - IWL-HQ-WRB-SS-87-7

SUMMARY

Water Survey of Canada makes use of automatic sampling systems for collecting suspended sediment data. The use of these systems permits better data coverage at stations and enables expanding the network at costs lower than for traditional methods and at sites with difficult access. In order to interpret and analyse the data from these new systems, it is necessary to have an in-depth understanding of the behavior of the factors causing the variability within each sampling method and amongst several sampling methods.

Intensive sampling of suspended sediment concentrations was carried out during the period from 23 March to 2 April, 1985 at the hydrometric station "BIG OTTER CREEK NEAR CALTON", 02GC026, in Ontario. The percentage of sand in suspension was particularly high. Sampling had been initiated in order to establish the variability in sampling methods and the correlations between them. The sampling methods studied were:

- five vertical sampling by the depth integrating method;
- single (control) vertical sampling by the depth integrating method;
- manual sampling at a point;
- automatic sampling at a point.

Simple and statified statistical sampling models, graphical interpretation and field observations were used in the analysis.

The study permits some quantitative demonstration of the differences amongst sampling methods and the types of samplers used for Canadian sampling sites. It has also provided an evaluation of the efficiency of the automatic PWS samplers. The precision of the sampling methods are notably similar and in the order of five percent for suspended sediments of the silt and clay sizes. Differences amongst the sampling types and methods have been observed to be more noticeable for sand size suspended sediments. Precisions from ten to twenty percent were observed. The precision of the manual point sampling is less sensitive to the presence of sand in suspension. Although single depth integrations are less precise then point integrations, the integrated sampling at five verticals estimates the mean concentration to a fairly good degree of precision. The confidence interval to 95% of the mean concentration was in the order of three percent for samples containing nearly fifty percent sand. The automatic PWS sampler was the instrument where the variability was the most sensitive to sand in suspension. It was also with this sampler that the largest quantity of outlier data were observed.

Results demonstrate that correlation between sampling methods is difficult to establish as both individual method precision and changing relationships between methods over the duration of a "sediment event"

influence the correlation. After removing the effects of sampling precision, the linear relationship defining the relationship between the manual methods has a standard error of estimate of six percent. The standard error was twelve percent for the correlations between the PWS automatic sampler and the manual methods.

This report allowed the establishment of the efficiency of the PWS automatic sampler. Although the use of this method increases the uncertainty of the data, the data are for the greatest part representative of the true behavior of the sediment in suspension. The principal weaknesses of this method are that both the data analysis and the correlation are actually difficult to establish. These weaknesses are evident for all automatic samplers. Other studies on automatic samplers are necessary before integrating this method into the Canadian network. The development of a data analysis program and evaluating the cost-benefit ratio of such a program are examples of studies to undertake.

McILHINNEY, J.L.
1987: Hydrographic Data Reduction and Analysis System Manual - HYDRA. IWD-HQ-WRB-SS-87-6.

BACKGROUND

What is HYDRA?

HYDRA stands for Hydrographic Data Reduction and Analysis system, developed for the Sediment Survey Section, Water Survey of Canada Division.

Its name implies its function, that is, to compute or reduce large volumes of hydrographic data collected from the field into a meaningful form from which pertinent analyses can be made.

HYDRA consists of a series of steps or stages in what is termed the HYDRA "process". These stages must be performed in a specific order. For example, the data which is obtained as the resultant from one stage, is the data to be input to the next stage.

For each stage of HYDRA, there are computer programs which perform the actual calculations on the data which is input. The HYDRA stages or 'PROCS' (from the word procedures) simply access which data to use, which program(s) to use on that data, and where to store the output data. Any errors detected by the computer in the data (or lack of data) will cause the program to "bomb", and an error message will appear on the computer printout to give an indication as to where the problem lies. Similarly, the PROC itself has built-in controls which ensure that the proper data has been inputted, inputted in the correct sequence, and stored or catalogued in its proper place for future use.

Throughout the process of HYDRA, a 377K memory computer, called the CYBER 730, is used. The computer is located at, and operated by, the Computer Science Centre (CSC), Department of Energy, Mines and Resources, Ottawa (telephone 996-0296).

CHURCH, M., McLEAN, D.B., KOSTASCHUK, R., TASSONE, B.
1987: Sediment Transport in Lower Fraser River: Summary of Results and Field Excursion Guide. IW/LD-HQ-WRB-SS-87-5.

PREFACE

The studies reviewed in this field guide form part of an investigation of the processes governing channel stability and sedimentation in lower Fraser River. A major task is to develop a long term sediment budget for the reach to aid port management below Port Mann. Toward that end, this report gives a review of the available sediment transport observations on the river, which are amongst the more comprehensive available for any river. These have been reconsidered in light of current developments in the analysis of sediment transport measurements. As a result, some aspects of prior analyses have been substantially revised.

It should be realised, however, that the results presented here remain preliminary. They have not been approved by the Water Survey of Canada and should not be regarded as final or authoritative.

A series of reports has been issued to inform the client of progress in this project as follows:

Church, M. McLean, D., Mannerstrom, M. and Evans, D. 1984.
Reference materials on sedimentation and morphology of the lower Fraser River. Environment Canada, Water Resources Branch, Sediment Survey Section. Report IWD-HQ-WRB-SS-85-1.

McLean, D. and Mannerstrom, M. 1985.
History of channel stability: lower Fraser River, Hope to Mission. Environment Canada, Water Resources Branch, Sediment Survey Section. Report IWD-HQ-WRB-SS-85-2.

McLean, D. 1985. Lower Fraser River Survey, 1984:
Agassiz-Rosedale Bridge to Mission. Environment Canada, Water Resources Branch, Sediment Survey Section. Report IWD-HQ-WRB-SS-85-3.

McLean, D. and Church, M. 1986.
A re-examination of sediment transport observations in the lower Fraser River. Environment Canada, Water Resources Branch, Sediment Survey Section. Report IWD-HQ-WRB-SS-86-6.

Copies of these reports may be obtained, upon request, from:

Head, Sediment Survey Section, Water Survey of Canada
Water Resources Branch, Inland Waters Directorate
Environment Canada, Ottawa, Ontario, Canada, K1A 0H3

ZRYMIAK, P.
1987: Linking Sediment Computations to a 1-D Mathematical Model, IWD-HQ-WRB-SS-87-4.

SUMMARY

In the 1880's under the Public Works Act, Public Works Canada (PWC) assumed responsibility for the maintenance and improvement of the navigation channel in the Lower Fraser River. It has spent millions of dollars on dredging, training structures, and other forms of river maintenance in the lower 25 miles (40 km) to ensure safe operating conditions for vessels entering its ports. In recent times, PWC has requested sediment data from Environment Canada to facilitate the planning of dredging and maintenance operations.

In 1964, Water Survey of Canada (WSC) began supplying sediment data to PWC. WSC used the Cubature method to compute discharge data up to 1968 and then the Power Series method from 1969 to 1972, however, WSC stopped supplying these data when it was concluded that these routing techniques (used to produce water discharge data for sediment load computations) were not sufficently accurate. Since then, WSC's primary objective at the Port Mann pumping station site on the Fraser has been to provide accurate water discharge data.

To achieve this objective, WSC obtained the assistance of the Water Planning and Management Branch (WPM), which had tested and applied a One-Dimensional (1-D) mathematical model to Canadian waterways. WSC asked them to apply the model using 1968 data (as it was the most intensively sampled year for sediment), to provide the discharge data, and to conduct a comparison with the Cubature method (published 1968 data). An account of their work is given by Bernard Morasse (WPM) in his report Generation of the 1968 Hydrometric Data of the Lower Fraser River, Using the 1-D Hydrodynamic Model. Morasse introduces a 1-D model which has been adapted specifically to the Lower Fraser River. He discusses routing methods and compares 1968 mean daily discharges produced by the cubature method to the 1968 discharges from the 1-D model.

This project's objective is to identify a method for producing reliable sediment loadings at the Port Mann site. This report discusses three procedures for computing sediment loads and presents 1968 loadings at Port Mann using these procedures. It compares the relative accuracy of the procedures and identifies the implications of applying the 1-D model.

The report concludes that the mean daily discharges from the 1-D model (using an hourly computation procedure) provides data that on an annual basis are 12% (range 10% to 26%) more accurate than mean daily discharges derived using the Cubature method.

The main recommendation of the report is to implement the hourly computation procedure for producing suspended sediment loadings, using discharges generated by the 1-D Model.

JORDAN, P.
1987: Impacts of Mass Movement Events on Rivers in the Southern Coast Mountains, British Columbia: Summary Report. IWD-HQ-WRB-SS-87-3.

ABSTRACT

A study has been conducted in the southern Coast Mountains of British Columbia to investigate the impact of terrain hazards on the geomorphology and flood hydrology of rivers. Such hazards include debris flows, slope failures in unconsolidated material and bedrock, and the drainage of moraine- or ice-dammed lakes. Impacts are most frequently due to the sudden introduction of large quantities of coarse sediment to a river channel. In rare cases, complete blockage of a river channel by a landslide or debris flow can be followed by an outburst flood.

A system for the classification and mapping of terrain hazards and their impacts on river channels has been proposed, and applied to a representative study area, the Squamish and Lillooet watersheds. In this study area, the most frequent and most severe impacts result from landslides and debris flows in Quaternary volcanic complexes. Most other river channel impacts result from debris flows originating in small, steep tributary basins. The potential for large slope failures which could completely block main-stem rivers exists in several locations. Although no longer a significant hazard in the study area, outburst floods from moraine- or ice-dammed lakes present potential hazards elsewhere in the Coast Mountains.

RESUME

On a réalisé une étude dans la chaîne côtière du Sud en Colombie-Britannique afin d'examiner les effets des accidents de terrain sur la géomorphologie et l'hydrologie des cours d'eau en période de crue. On entent par de tels accidents des coulées de débris, l'éboulement de matériaux non consolidés et de la roche-mère, ainsi que le drainage de lacs de barrage par moraine ou de lacs de barrage glaciaire. L'introduction soudaine de grandes quantités de sédiments grossiers dans le chenal d'un cours d'eau entraîne le plus souvent ces effets. Dans de rares cas, un glissement de terrain ou l'écoulement de débris peut bloquer complètement le cours d'eau, et une inondation subite peut s'ensuivre.

On a proposé un système visant à classifier et à cartographier les accidents de terrain et leur incidences sur les chenaux des cours d'eau et on l'a appliqué à une région d'étude représentative, celle des bassins versants des rivières Squamish et Lillooet. Dans cette région, les incidences les plus fréquentes et les plus graves sont dues à des glissements de terrain et à des coulées de débris dans les complexes volcaniques du Quaternaire. Des coulées de débris en provenance de petits bassins tributaires profonds sont la cause de la plupart des autres incidences sur les chenaux. De graves éboulements qui

bloqueraient entièrement les branches principales de cours d'eau pourraient se produire à plusieurs endroits. Bien que les inondations subites dues à des lacs de barrage par moraine ou à des lacs de barrage glaciaire ne présentent plus de dangers potentiels ailleurs dans la chaîne cotière.

YUZYK, T.R.
1987: Bed Degradation of the South Saskatchewan River below Lake Diefenbaker. IWD-HQ-WRB-SS-87-2.

ABSTRACT

The creation of Lake Diefenbaker in Saskatchewan has resulted in significant changes in both the flow and the sediment regime of the South Saskatchewan River below Gardiner Dam. Bed changes are assessed using the cross-sectional and bed material data that were collected from the mid-1960s to 1985.

Degradation appears to be significant only at the ranges (R) nearest the Gardiner Dam. Based on minimum bed elevation, the largest change occurred at R-1-0 where 1.7 m was eroded between 1967 and 1985. Data relating to mean cross-sectional changes indicate the largest change, 0.67 m, for this period was at R-2.7. During the first ten years after closure of the dam changes occurred rapidly. In recent years, however, there has been a stabilization. This has been attributed to bed armouring, as indicated by the increase in median grain size (D_{50}) from 0.24 mm (1968) to 2.50 mm (1985) at R-1.0.

The flow model MOBED was found to overestimate the rate and extent of degradation. For R-1.0 and R-2.7, MOBED overestimated the rate between 1967 and 1985 by two and three times, respectively. The model over estimates because it does not take armouring into account. MOBED should be run again, this time using the newly developed sorting algorithm to see whether the model's predictive capability is improved.

It is also advocated that a much reduced survey, only covering from the dam to R-8.0, should be conducted in 1990; or directly following a release $\geq$ 1500 m^3/s. There is need to develop better bed material sampling methods to improve on the documentation of the armouring process. The role that large events play is not well understood from the existing data base and therefore this aspect warrants more work. The re-establishment of the Saskatoon station is important to provide further information on the sediment transport regime of the South Saskatchewan River.

CASHMAN, M.A.
1987: Repeatability and Sensitivity Study of Suspended Sediment Data Computation. IWD-HQ-WRB-SS-87-1.

ABSTRACT

This project was initiated to determine the repeatability of suspended sediment loads produced by standard Water Survey of Canada methods. The sensitivity of loading values were also examined. The study was conducted using the suspended sediment concentration data and the original records for 1969 for the sediment sampling station Assiniboine River at Headingley (05MJ001).

The awareness of uncertainties in sample collection techniques, computation, and their affect on the sediment loads, as well as concern for the increasing cost of collecting and analyzing suspended sediment samples have led to the review of sampling strategies. This included a review of the number of cross-section measurements taken, and the increased reliance on data obtained from single vertical sampling. The number of measurements and single vertical samples were reduced for each test.

The analysis indicates that the sample coverage can be reduced considerably. The usual high volume of sampling must be maintained during the freshet while sampling during the winter months can be deleted. The reduced sample collection resulted in a repeatability of the annual loads to within 5% while showing a reduction in laboratory costs of approximately 80%. This study also shows that large errors may affect individual days or short periods due to sampling strategies, but when comparing the total annual loads the differences are insignificant. Furthermore the results indicate that the use of the K factor is not warranted if total annual loads are the only interest.

RESUME

Ce projet avait pour but de déterminer s'il est possible de reproduire les résultats obtenus sur le transport des matières en suspension grâce aux méthodes utilisées couramment à la Division des relevés hydrologiques du Canada. On a également examiné la sensibilité des valeurs sur le transport solide. L'étude portait sur les données relatives à la concentration des matières en suspension et sur les observations enregistrées en 1969 à la station d'échantillonnage des sédiments de la rivière Assiniboine à la hauteur de Headingley (station 05MJ001).

Etant donné les doutes émis au sujet des techniques de collecte de données et de calcul ainsi que de leurs effets sur les données portant sur le transport solide et compte tenu des inquiétudes entourant le coût croissant de la collecte et de l'analyse des échantillons de matières en suspension, on a passé en revue les stratégies d'échantillonnage.

On a donc examiné le nombre de mesures effectuées sur des coupes transversales et la fiabilité accrue des données obtenues au moyen d'un échantillonnage sur une seule verticale. On a ensuite réduit, pour chaque test, le nombre de mesures et d'échantillons prélevés sur une verticale unique.

Selon l'analyse, le nombre d'échantillons peut être réduit considérablement. On doit maintenir le volume habituellement élevé d'échantillonnages durant la montée des eaux, tandis qu'on peut supprimer tout échantillonnage en hiver. En réduisant le nombre de prélèvements, on a reproduit à près de 5% les données sur le transport annuel et calculé une baisse d'environ 80% des coûts de laboratoire. L'étude démontre aussi que l'utilisation des stratégies d'échantillonnage peut entraîner des erreurs importantes certains jours ou pendant de courtes périodes; ces écarts sont toutefois négligeables lorsqu'on les compare aux données concernant le transport annuel total. L'étude précise enfin que l'utilisation du facteur K est injustifiée si on s'intéresse uniquement au transport annuel total.

POL, R.A.
1987: Interpretation of Sediment Data, 1966-1984, Kennebecasis River, New Brunswick. IW/L-AR-WRB-87-129.

ABSTRACT

Sediment data have been collected at the hydrometric gauging station site, Kennebecasis River at Apohaqui, from 1966 to the present as part of the ongoing Water Resources Branch National Sediment Surveys Program. This report deals primarily with suspended sediment data collected during the period 1967 to 1984, inclusive, and presents the collected data in various tabular, graphical and statistical ways. It also contains a basin description and a section on land use and river sediments. The suspended sediment program, operated by the recommendations are presented. This material is intended for Federal/Provincial co-ordinators of water agreements, Water Survey of Canada staff and users of sediment data.

The analyses and interpretations of the sediment data are the purpose of assessing if sufficient data exist for load determinations. The interpretation of the suspended sediment data set showed that our knowledge of mean characteristics of the sediment regime can improve only slights; therefore, it is being recommended that the sediment station be discontinued.

RESUME

Des données sédimentologiques ont été prélevées à la station de relevés hydrométriques de la rivière Kennebecasis à Apohaqui à partir de 1966 jusqu'à présent. Ces prélèvements font partie du Programme national d'échantillonnage sédimentologique de la Direction des ressources en eau.

Ce rapport traite principalement de données sur les sédiments en suspension collectionnées durant la période de 1967 à 1984 et les présente sous formes de tableaux, de graphiques et de statistique. Le rapport comprend aussi une description du basin, une section sur l'utilisation du terrain, ainsi qu'une section sur les sédiments de rivière. Le rapport fait une évaluation du programme sur les sédiments en suspension de la Division des relevés hydrologiques du Canada et offre aussi des recommendations. Ce travail sera utile aux coordonateurs des ententes fédérales-provinciales sur l'eau, aux employés de la Division des relevés hydrologiques du Canada et aux usagers de données sédimentologiques.

Les analyses et les interprétations effectuées sur les données sédimentologiques ont permis d'évaluer la suffisance des données sur les sédiments en suspension pour en calculer le débit solide. Celles-ci ont montré que notre connaissance du régime sédimentologiques en terme de production moyenne n'augmenterait pas sensiblement avec plus de données et qu'ainsi l'échantillonnage peut être discontinué.

BINDA, G.G.
1987: Sediment Data Reference Index for Ontario. IWD-OR-WRB-SS-87-2.

ABSTRACT

This report consists of a reference index of available sediment data (fluvial and lacustrine, except for the Great Lakes) for Ontario. It is divided into a section on data collected by various public and private agencies and a second on data contained in published specific studies.

Both sections are separated alphabetically by major drainage basins within which the individual stations or rivers are also listed alphabetically.

Information available in the index are station name, number and location, collecting agency, sampling method, station purpose and the period of record for 1) suspended sediment (concentrations, loads and particle size), 2) bedload, 3) bed sediment particle size and 4) dissolved solids.

RESUME

Ce rapport est un index de référence portant sur les données en sédiments (fluviaux et lacustres, à l'exception des Grands Lacs) disponible pour l'Ontario. La première section identifie les données recueillies par des agences publiques et privées. Une deuxième section identifie les données contenues dans les études spécifiques publiées.

A l'intérieur de chaque section, les données sont référées alphabétiquement selon les bassins versants principaux et leurs stations ou rivières.

Les informations fournies par cet index sont le nom, le numéro et la localisation de la station, l'agence des prélèvements, la méthode d'échantillonnage, l'objectif de la station et la période d'étude pour 1) les sédiments en suspension (concentrations, débits et granulométrie), 2) le charriage de fond, 3) la granulométrie des matériaux de lit et 4) les solides dissouts.

BINDA, G.G.
1987: Ontario Sediment-Related Literature: Annotated Bibliography. IWD-OR-WRB-SS-87-1.

ABSTRACT

This report consists of a compilation of reference material pertaining to sediment in Ontario streams and lakes (excluding the Great Lakes).

It is divided into two sections: 1) references and abstracts and 2) a subject cross-reference index. Subjects cover a wide range of interests such as quality aspects of sediments (adsorbed contaminants and metals), erosional processes, sediment transport in rivers, sedimentation in reservoirs and lakes, and water quality aspects. In addition the subject list contains the names of the rivers and lakes.

RESUME

Ce rapport est un catalogue de références concernant les sédiments dans les rivières et lacs de l'Ontario (escluant les Grand Lacs).

Il est divisé en deux sections : 1) références et résumés et 2) un index de renvois par sujet. Les sujets englobent une large gamme d'intérêts tels la qualité des sédiments (contaminants et métaux adsorbés à la surface), les processus d'érosion, le transport de sédiments dans les rivières, la sédimentation dans les réservoirs et les lacs et la qualité des eaux. En plus, la liste de sujets contient les noms des rivières et lacs.

HUDSON, H.R. and ASKIN, R.W.
1987: An Interpretive Study of the Upper Oldman River Sediment Regime. IWD-WNR(A)-WRB-SS-87-3.

ABSTRACT

Sediment sources and controls on suspended sediment transport are examined in the Oldman River basin above Brocket in Southwestern Alberta. The major sediment sources in the 4 400 km^2 river basin were isolated by constructing a sediment budget from existing sediment records, delimiting sediment sources using aerial photograph and site inspections, and constructing topographic maps of major erosion sites from 1965 and 1985 aerial photographs to calculate erosion losses. Additional inferences on sediment sources were gained from a comparison of particle size distributions, cesium-137 content, and petrographic variations from sediment sources, river channel deposits and sediment load at the Brocket hydrometric station. This information was combined with a description of physiography and climatology to interpret the suspended sediment regime of the Upper Oldman River basin.

The annual suspended sediment load of the Oldman River near Brocket (05AA024) is about 275 000 tonnes, with a standard error of estimate of 30 percent. The sediment budget indicated that the major suspended sediment contribution areas in the Upper Oldman River basin are, in order of importance: (1) the lower basin area of the Oldman, Castle and Crowsnest Rivers (about 190 000 t/y); (2) the Castle River foothills and mountains (40 000 t/y); (3) the Oldman River above Waldron's Corner (34 000 t/y); (4) Mill Creek (6 000 t/y); and (5) the Crowsnest River above Frank (4 000 t/y). These estimates are based on fewer data, and are less reliable than the annual load estimate at Brocket.

The sediment regime of the Oldman River near Brocket is explicable in terms of the interaction between the hydrologic response and sediment sources. Smaller magnitude annual floods are generated largely from snowmelt in the foothills and mountains. As the magnitude of the flood increases, the rainfall component tends to increase and the contributing area expands to include the plains. The largest floods occur with heavy rainfall in the spring when the ground is saturated and snowmelt runoff occurs.

The Cardston Plain area dominates the sediment yield of the Upper Oldman River basin above Brocket. Sediment is derived from gully erosion and tributary channel enlargement and incision to base level on the plains, toe erosion of large mass movement deposits which impinge upon the river channel, and general channel erosion. Erosion occurs mainly in the spring as the result of snowmelt and/or rainfall. Occasionally, in the summer during the snowmelt recession of the Oldman River, heavy rainfall may generate pulses of sediment from the plains.

Upland contributions from the mountains and foothills are limited because of the forest cover and limitations in fine sediment supply. The major sediment sources and processes in these areas are surface was of non-vegetated colluvial slopes, and channel and riparian erosion. Runoff from the barren colluvial slopes is generated largely by snowmelt over a period of days to weeks in the spring and generally coincides with the annual flood of the Upper Oldman River. Sediment contributions from channel and riparian sources occur as the result of flushing of readily erodible material at the toe of the river banks and valley walls. The material is sediment supply limited, which accounts for the high initial sediment concentrations on the rising limb of the flood hydrograph and the decreases in concentration with subsequent hydrograph rises. Conceptual descriptions of the processes are presented to describe these relationships.

As a result of these controls, the bulk of the annual suspended sediment transport of the Upper Oldman River occurs in a short period during the annual flood. Subsequent flood peaks contribute progressively less material as the result of sediment supply exhaustion. In some cases, high sediment loads may occur following the spring flood peak as the result of largely rainfall generated floods which cause bank erosion or upland riparian erosion.

An evaluation of methodologies employed in this interpretation of the sediment regime of the Upper Oldman River basin indicates the following:

(1) Good quality sediment records are essential in any such study, preferably at several relevant locations upstream. These records should be available in the form of the report presented by Day and Spitzer (1985), "Sediment Station Analysis, Oldman River Near Brocket".

(2) Aerial photographic reconnaissance can provide a good overview of sediment sources in a drainage basin. However, field inspection revealed a number of difficulties in interpretation in this study, and in previous work. Thus, field inspection is essential in any such future studies.

(3) Detailed topographic mapping from sequential aerial photographs provides a cost effective means of quantifying point source contributions and indicates where this erosion occurs, which is essential for inferring erosion processes.

(4) The analysis of sediment attributes such as particle size distributions, cesion-137 content, and petrographic variations of sediment sources, channel deposits and sediment yield from the basin, provide support for the interpretation developed using the aforementioned approaches.

(5) The major limitation to this type of study is that erosion processes have to be inferred from various lines of evidence. The accuracy of these inferences is dependent on the experience of the observer.

HYDROCON ENGINEERING (Continental) LTD.
1987: Sediment Station Analysis: Red Deer River at Red Deer (05GC002), at Drumheller (05CG001), near Bindless (05CK004), IWD-WNR(A)-WRB-SS-87-1.

ABSTRACT

The Water Resources Branch of Environment Canada has operated major sediment data collection programs on the Red Deer River, at Red Deer, at Drumheller and near Bindloss, which was established, respectively, to monitor sediment discharge for reservoir planning, to determine sediment laods due to contribution from the Badlands, and to assist in determining sediment loads into Lake Diefenbaker.

Data from all three sites, from 1966 until suspension of the detailed monitoring programs at the end of 1984, has been analysed and summarized. Based on these analyses, it has beenconcluded that the suspended sediment transport characteristics and sediment yield of the Red Deer River at Red Deer, at Drumheller and near Bindloss generally have been well documented by the existing data base. Further intensive data collection will not improve the overall understanding of suspended sediment transport at these sites. However, as discharges during the detailed sediment sampling period were lower than long-term mean flows, future miscellaneous data collection programs should attempt to measure loads for extreme events beyond those covered by the present data base.

This report also evaluated the suspended sediment transport regime of the Red Deer River, and identified trens and patterns in the data between the three sites. Sediment yield from the Badlands and throughout the river basin in general was discussed, and the long-term effects of Dickson Dam operation on sediment transport was examined and found to be minimal.

RESUME

L'agence de Resource des Eaux d'Environnement Canada a conduit d'importants programmes de collection de données sur les sédiments de la rivière Red Deer à Red Deer, Drumheller et près de Bindloss. Ces programmes avaient pout but, respectivement, de contrôler les déchargements de sédiment pour la planification d'un réseroir, de déterminer le chargement de sédiment dû à la contribution des Badlands, et d'assister à la détermination du chargement de sédiment dans le lac Diefenbaker.

Les données recueillies sur ces trois sites, depuis 1966 jusqu'à la suspension du programme de contrôle détaillé à la fin de 1984, ont été analysées et résumées. Basé sur cette analyse, il a été conclu que les charactéristiques de transport de sédiment supendu et l,apport de sédiment de la rivière Red Deer à Red Deer, à Drumheller et près de Bindloss ont été généralement bien documentées par la banque de données existante. Une collection plus intensive de données n'améliorerait pas la compréhension générale du transport de sédiment suspendu. Cependent, étant donné que les déchargements durant la période d'échantillonnage détaillé de sédiment était inférieurs à l'écoulement moyen à long terme, un programme de collection de diverses données deurait à l'avenir essayer de mesurer les chargements pour les événements extrêmes au-delà de ceux qui ont été couverts par la présente banque de données.

Ce rapport évalue également le régime de transport de sédiment suspendu de la rivière Red Deer et identifie les tendances de données entre les trois sites. L'apport de sédiment des Badlands, et au travers du bassin de la rivière en général est discuté. Les effets à long terme des opérations effectuées sur le barrage Dickson sur le transport de sédiment ont été examinés et il a été trouvé que ces effets sont minimes.

PENNER, F., YUZYK, T.R., OSHOWAY, R.
1987: A Compilation of Manitoba Sediment Data to 1985, 200 p., IWD-WNR(M)-WRB-SS-87-3.

ABSTRACT

This report is a compilation of all the suspended sediment and bed material data that have been collected in Manitoba by the Manitoba Water Resources Branch and Water Survey of Canada. There is a total of 63 sites in the province where sediment data have been collected. The data are presented in various formats, with a possible nine figures and three tables used to depict the information for each site. Data collected by other agencies are also referenced. The information from this compilation will be used to help evaluate the sediment program in Manitoba.

HYDROCON ENGINEERING (Continental) LTD.
Sediment Station Analysis: Pembina River near Windygates
05ØB007, IWD-WNR(M)-WRB-SS-87-2.

ABSTRACT

This is one of a series of sediment station analysis reports issued by the Water Resources Branch of Environment Canada. It presents a summary and analysis of the sediment data for the Pembina River near Windygates, Manitoba, (Sta. 05OB007), for the period 1962-1984. The data have also been assessed in terms of the use of sediment rating curves, water quality concerns, and reservoir sedimentation studies.

It has been concluded that the available sediment data on the Pembina River near Windygates sufficiently describe the present sediment regime, and that the detailed sediment data collection program should be suspended. It is recommended that a miscellaneous sediment data collection program should be suspended. It is recommended that a miscellaneous sediment data collection program be instituted, which could run in conjunction with a short-term water quality sampling program aimed at studying organic contaminant loading. The miscellaneous program should also aim to measure suspended sediment concentrations for extreme high and low flows, as well as particle sizes for low concentrations.

YUZYK, T.R.
1987: Proceedings of the Manitoba Sediment Issues Workshop: November 18-19, 1986, Winnipeg, Manitoba. IWD-WNR(M)-WRB-SS-87-1.

ABSTRACT

It is becoming increasingly apparent that sediment is an important component in the evaluation of a broad range of environmental issues. In Manitoba, sediment data are used in the assessment of numerous water resources projects such as determining the life expectancy of a reservoir, identifying the effects of a diversion scheme or the designing of irrigation and drainage systems. Water quality studies are starting to focus on the role sediment plays in the sourcing, transfer, and fate of many pollutants. In fisheries, increased sediment concentrations impact negatively on the commercial and recreational fish populations in many areas of the province. Even in agriculture, sediment found in streams translates into lost productive soil from farm lands and into increased maintenance costs to irrigation systems.

The workshop brought together over fifty representatives from consulting firms, universities as well as from federal and provincial governments to identify sediment issues and to comment on the existing network of stations. The information obtained from this workshop is being applied by both the federal and provincial Water Resources Branches as part of an evaluation of the Sediment Program in Manitoba.

ASHMORE, P.E.
1987: Sediment Station Analysis: North Saskatchewan River at Prince Albert - 05GG001, IWD-WNR(S)-WRB-SS-87-1.

ABSTRACT

The Water Survey of Canada has operated a sediment station at Prince Albert (05GG001) since 1962. Until 1979 the data were collected year-round but since then the program has run between April and October only. Data are collected at a stable cross section in which the bed material is predominantly sand with gravel present on some small unstable bars.

Mean annual suspended sediment load is 3.09 x 10 t for the period 1963-1979 when annual flows were slightly above average. Annual flow and load declined through the late 1970s and early 1980s. Much of the annual load is transported during peak flows in April and July. The operation of Bighorn Dam since 1972 appears to have altered the flow and load regime such that April is now the dominant month instead of July. However, seasonal operation since 1978 has limited the amount of data available with which to assess this effect.

The existing particle size data are more than adequate to characterize the size distribution of the suspended sediment. The dominance of washload and possibly the homogeneity of the sediment sources result in the lack of an obvious trend in particle size with discharge. Point integrated sampling reveals the presence of some substantial variation in concentration across the channel, notably in the sand fraction.

While the existing data are generally adequate for regime characterization, it is recommended that an effort be made to better characterize the sediment regime since construction of the Bighorn Dam. In addition, establishment of seasonal stations in the basin upstream of Prince Albert may be necessary if major flow regulation projects are planned and also to provide background information on the major sources and fate of sediment in the basin.

Résumé

La Division des relevés hydrologiques du Canada exploite depuis 1962 une station sédimentologique à Prince-Albert (05GG001). Jusqu'en 1979, les données étaient recueillies pendant toute l'année, mais depuis, elles ne le sont que d'avril à octobre seulement. La collecte de données se fait dans une section sable et de gravier présent sur quelques petits bancs instables.

De 1963 à 1979, alors que les débits annuels étaient légèrement supérieurs à la normale, la charge moyenne annuelle en sédiments en suspension était de 3,09 x 10t. La charge et le débit annuels ont diminué vers la fin des années 70 et au début des années 80. La plus grande partie de la masse annuelle des sédiments en suspension est transportée pendant les débits de pointe d'avril et de juillet. Il semble que l'exploitation du barrage Bighorn depuis 1972 ait modifié le

régime; maintenant, c'est avril, et non plus juillet, que est le mois dominant. Toutefois, l'exploitation saisonnière de la station depuis 1978 a réduit le nombre de donnée permettant de mesurer cet effet.

Les données déjà recueillies sur la dimension des particules sont plus que suffisantes pour établir la distribution granulométrique des sédiments en suspension. En raisonade la pr.domonance de la charge de ruissellement et peu-être de l'homogénéité des sources de sédiment, il n'existe pas de tendance évidente de la dimension des particules avec les débits. Les résultats de l'échantillonnage ponctuel par intégration indiquent d'importantes variations de la concentration d'un côté à l'autre du canal, notamment là où le lit est composé de sable.

Bien qu'en général les données actuelles soient suffisantes pour déterminer les caractéristiques du régime, il est recommandé de mieux définir celui des sédiments depuis que le barrage Bighorn a été construit. En outre, il serait peut-être nécessaire d'établir des stations saisonnières dans le bassin en amont de Prine-Albert si d'importants projets de régularisation du débit sont prévus ainsi que pour fournir des données de base sur les principales sources de même que sur le devenir des sédiments dans le bassin.

LEWIS, C.P. and ASSOCIATES.
1987: Mackenzie Delta Sedimentary Environments and Processors: Issues and Recommendations. IWD-WNR(NWT)-WRB-SS-87-2.

SUMMARY

The modern Mackenzie Delta is an active sediment surface which supports a large and vulnerable arctic/sub-arctic ecosystem that is very important to the traditional lifestyle and economy of the people of the region. The delta, including its ecosystem, has been created by and remains highly dependent on the Mackenzie River sediment that is disbursed through it by the distributary channel network. In addition, recent estimates suggest that the Mackenzie supplies about 96 percent of the sediment delivered annually to the Beaufort Sea. The nature of delta sedimentary environments, including the processes associated with them, therefore, will have major significance for engineering design on the delta surface. The danger exists, as well, that any development upstream from or on the delta plain that could affect sediment movement within or through the delta, could also significantly impact many other ecosystem components, both on the delta itself and throughout the bordering Beaufort Sea.

In spite of development pressures over the past 15 years, the data base relevant to all aspects of sediment movement and storage within the Mackenzie Delta remains largely inadequate for practical application. Several significant but limited studies were undertaken in the 1960's by Mackay (1963) and others (e.g. Gill, 1976; Smith, 1973) in the 1970's in association with proposals for a Mackenzie Valley gas pipeline and energy corridor. Since then, considerable work has been undertaken offshore but the only major onshore initiative has been the examination of distributary channel processes by Lapointe (1984). B.C. Hydro proposed an extensive investigation of "Mackenzie Delta Sedimentation" as part of its Liard River Hydroelectric Development studies but the project was cancelled while still in its initial stages.

The recommendations for future study which follow recognize the general limitations in our knowledge about sedimentary environments and the processes on the Mackenzie Delta but are intended to focus work on the topics of most immediate practical concern and to suggest approaches to those topics which will provide the greatest benefit for the least cost. The recommended studies are not presented in any order of priority. That will depend upon the individual perspectives of potential users and of the agencies that must fund the work.

CHURCH, M., MILES, M. and ROOD, K.
1986: Sediment Transport along Mackenzie River: A Feasibility Study. IWD-WNR(NWT)-WRB-SS-87-1.

INTRODUCTION

Although it is one of the major rivers of North America, the remoteness of Mackenzie River has discouraged study of it. Hence, channel hydraulics and sediment transport remain poorly known. Proposed resource developments along the river and the desirability to develop a regional water management plan now require that knowledge of these phenomena be improved more rapidly than could be achieved by the expansion of conventional monitoring programs alone.

Information on sediment transport characteristics can be obtained from non-traditional sources. Specifically, historic planimetric and topographic surveys, aerial photographs and hydrographic sounding, supplemented with limited observations of sediment transport, might be used to construct an approximate sediment budget on a reach-by-reach basis.

In the long term, understanding the viability of alluvial ecosystems requires that the character of erosion and sedimentation be understood on a reach basis. It is appropriate to draw evidence from morphological and sedimentary studies, rather than just from sediment transport monitoring, because information of the appropriate character and resolution can be gained in that way. Net change within reaches - rather than total throughput of sediment - is critical for river stability. Further, it requires many years' monitoring, conducted at great expense, to establish the trend of river stability. Where map, chart, or air photo evidence is available, trends can be established from the observed pattern of changing morphology.

Some monitoring remains important in order to permit more detailed interpretation of net morphological changes in terms of a sediment budget.

The present project resulted from a request by Dr. T.J. Day, Head, Sediment Survey of Canada, to Professor Michael Church, at the University of British Columbia, to consider whether map and photo records could be used to obtain useful information on Mackenzie River. Because there is relatively little information available on the river, it is prudent first to undertake a feasibility study of the approach.

LAPOINTE, F.
1986: Etude du comportement hydraulique de l'échantillonneur automatique PWS. IWD-HQ-WRB-SS-86-12.

SUMMARY

The evaluation of the precision and the improvement of the automatic suspended sediment sampler, PWS, are two important projects of the Sediment Survey Section.

The principal factors influencing the precision of the PWS are: the shape and the size of opening (diameter of the intake), the intake velocity and the capacity of the hydraulic system. Ironically these factors concerning the PWS have never been thoroughly studied. Taking this into consideration, several tests were conducted at the NWRI Laboratory (Burlington) in August, 1984.

This report provides an insight into the different tests and their results. Comments and possible applications of the results for future installations are also presented. From the interpretation of the test results, the following recommendations are presented for improving the hydraulic aspects of the PWS:

1) Eliminate the Water Motor from the Control Unit of the PWS;

2) Improve the bottling system by reducing the flow resistance in the following manner:

   - eliminate the roughness caused by the protrusion of secondary pipes in the collector system,

   - eliminate the constriction of the soft tubing used as elbows for the manifold;

3) Reduce the diameter of the sampler inflow by adapting a nozzle. Prototype nozzles are suggested in Section 2.7, however, further study should be carried out to improve the nozzle design.

4) Outflow from the manifold should be released to an open system (i.e. released to atmospheric pressure).

This is one step in a series of investigations about the PWS. Additional investigations must be carried out to determine the correlation between the PWS results and the single vertical sampling results. The design of the PWS must be improved in order to increase sampling efficiency and to facilitate instrument operation.

HYDROQUAL CONSULTANTS INC.
1986: Total Dissolved Solids Trends in the Saskatchewan River Basin. IWD-HQ-WRB-SS-86-11.

SUMMARY

The Water Resources and Water Quality Branches of Environment Canada have, over the past three decades collected total dissolved solids (TDS) data from surface waters throughout the Saskatchewan River Basin. The Water Resources Branch (WRB) collects TDS as an adjunct to their sediment monitoring program, for the purpose of calculating geochemical yield. Water Quality Branch (WQB) collects TDS samples at their fixed river monitoring stations, and at special project sites, for definition of baseline conditions and assessment of trend in concentrations.

The total database consists of 33,585 samples, which includes 9,771 samples collected by WQB and 23,814 by WRB. Data have been collected at 223 locations. Water Quality Branch has data for 180 sites, WRB for 85 sites and there are 42 sites which overlap. The database is extensive, i.e. greater than 100 samples over at least 5 years, for 64 of the 223 total sites. Thirty-one of these long-term sites are actively sampled by one or other agency. Out of a total of 57 active stations, only 5 sites are currently sampled by both agencies.

The historical database generally covers the entire basin adequately, with a few minor exceptions including the northern tributaries of the main-stem Saskatchewan River and the South Saskatchewan River downstream of the Alberta border. A large proportion of the total sites sampled, 106 of 223, are located along the east slopes of the Rocky Mountains.

The daily TDS concentration of rivers in the Saskatchewan basin can be adequately characterized by one depth integrated sample collected at mid-channel. There is no need for a multiple-vertical sampling strategy, as is required for suspended solids. This means that despite differences in sampling strategy between WRB and WQB, this factor does not need to be accounted for when combining data from both sources. However, WQB data should be multiplied by 1.055 to compensate for analytical differences. WQB estimates TDS by sum of ions, whereas WRB used a direct gravimetric technique.

The TDS record at many points in the basin is substantial, and permits powerful time series analyses. WQB data, which follows a fixed monthly schedule, is more useful in this respect than WRB data which emphasizes high flows and open-water months. The principal long-term trends in TDS concentrations across the basin relate to flow regulation on the North and South Saskatchewan Rivers, which depresses the natural winter TDS maximum, and reduces the annual variance in concentration. More subtle effects from altered land use or increased effluent loadings

are not apparent on the South Saskatchewan at Highway 41, or the Red Deer River at Bindloss, but a trend of slowly increasing TDS concentration is detectable on the lower Bow River. Municipal wastes or irrigation return flow are probably responsible for this increase. Dams recently completed or under construction on the Red Deer and Oldman Rivers are expected to disrupt the annual TDS pattern in a manner similar to that experienced by the other regulated rivers in the basin.

In both the ice-cover and open-water seasons, there is a general increase in tributary TDS concentrations from west to east, with concentrations being low in the western sub-basins, intermediate for the North Saskatchewan and Battle sub-basins and high in the eastern sub-basins draining Saskatchewan and Manitoba. The first TDS means >500 mg/L are found in prairie streams at least 100 km east of the mountains. At the opposite end of the basin, in eastern Saskatchewan, concentrations are seldom <500 mg/L and values >1000 mg/L are commonplace.

Main-stem rivers had a nearly constant mean TDS concentration across the basin, ranging between 200 and 300 mg/L, with only a subtle increase from west to east. This trend indicates that dilute mountain runoff dominates main-stem river water concentrations throughout the basin, despite the influx of ion-rich water from the tributaries. The higher main-stem concentrations in the Battle River arise because this sub-basin, and no other, is free of the influence of mountain runoff.

Geochemical loads calculated from WQB data, WRB data or all data combined usually differ by 10% or less, except in winter when under-sampling by Water Resources Branch causes inflated loading estimates. For all other seasons, or annual estimates, data from either Branch will produce reliable results. At most locations, sampling for 10 years will produce estimates of mean TDS loads with a standard error of 10-15%. Sampling beyond this limit will not improve precision of the loading estimate; unless information on changes in load through time is required.

Most of the annual TDS load is carried during the open-water season; the small proportion carried during ice-cover increases with increasing regulation of stream flow. Rates of geochemical yield are greatest for the mountain and foothill areas relative to the prairies.

McILHINNEY, J.L.
1986: Station Review Plot Package. IWD-HQ-WRB-SS-86-10.

ABSTRACT

The following pages contain:

1) general information on acquiring plots and listings;
2) specific information you need to know about a station and selected plots before requesting plots;
3) a blank Plot Request form;
4) sample plots and listings.

Before requesting plots you should have an idea of the history of the station and which plots would be beneficial. Each plot costs between $2.00 and $10.00 while a total set of plots for one station would cost between $100.00 and $200.00 (before rebate, if applicable). Because of the costs for obtaining the plots, the amount of requests for plots and the limitations of our budget, it has been decided that small requests for plots will be handled through our Section, but larger requests should be done by your own Region. This can be done by filling out a form for an interactive account from Computer Services Center, E.M.R. Once this is complete and you have an account, you can run your own plot requests from your office using DATAPAC. Most of the plots can be requested by:

1) Enter "LOGIN,username,password." Press <RETURN> key.
2) Enter "ATTACH,X,PLOT,ID=PACKAGE1,PW=SSS,MR=1.". Press <RETURN> key.
3) Enter "IGET,A=START/X.". Press <RETURN> key.
4) Enter "BEGIN,START,A.". Press <RETURN> key.

Then follow the user friendly instructions to obtain the desired plots.

If you have any questions please call Joseph McIlhinney at (819) 997-1185.

ASHMORE, P.E.
1986: Suspended Sediment Transport in the Saskatchewan River Basin. IWD-HQ-WRB-SS-86-9.

ABSTRACT

Compilation and analysis of suspended data from Water Survey of Canada sediment stations in the Saskatchewan River basin shows that sediment yield are highest in the Alberta Plains portion of the basin and are particularly high along sections of the Oldman River and Red Deer River (greater than 100 t $km^{-2}a^{-1}$). The Mountain and Foothills basins generally have yields of between 10 and 40 t $km^{-2}a^{-1}$. This produces the unusual tendency for yield to increase, rather than decrease, downstream along the main rivers. The ratio of annual load to annual flow follows a very similar pattern. Frequency distributions of daily yield and concentration show that the large Prairie streams have higher median values than the Eastern Slopes basins but that the latter have more strongly skewed distributions and peak values quite close to those of the Prairie rivers. The basins with entirely Prairie runoff sources also have strongly skewed distributions of daily concentration and yield. Comparison of data between stations is complicated by differences in the period and length of the sediment record.

The greatest amount of information, from a total of 112 sediment stations is derived from 23 "seasonal/continuous" stations with over 4 years of record. By comparison the "miscellaneous" stations provide very little information apart from long-term load estimates whose accuracy is difficult to verify.

Monthly mean load follws an annual pattern of variation very similar to that of discharge. Close to the Mountains there is a single peak in May or June, while in the large Prairie rivers two peaks often occur associated with spring runoff on the plains and later mountain snowmelt. Clockwise seasonal hysteresis in concentration is common, but some complications arise under regulation by upstream reservoirs.

The small Eastern Slopes basins tend to have larger proportions of their total load transported by extreme events larger than the mean annual flood and to have a great proportion of their annual load transported in fewer days than the large Prairie basins. In most cases, the "effective" discharge for the Eastern Slopes basins has a lower frequency of exceedance than that of the Prairie basins.

There is a tendency for the average particle size of the suspended sediment load to decrease downstream along the main rivers as greater proportions of silt and clay are added to the load. However, large sediment traps, such as Lake Diefenbaker, now interfere with this pattern. It is difficult to discern any systematic relationship between particle size and stream discharge, especially in the large Prairie rivers and the collection of data primarily during spring and early summer precludes analysis of trends through the year in particle size.

Review of data from other major drainage basins is recommended along with assessment of the miscellaneous data program and the particle-size analysis program. Future main-stem network changes should concentrate on the North Saskatchewan River. The impact of impoundment on the Cumberland Delta and on the Red Deer River downstream of Dickson Dam should be investigated. Future research should be aimed at sediment routing from the land through the stream network in basins of various drainage areas. This information can be used in tracing sediment-associated pollutants and in refining predictive models of suspended sediment yield.

YUZYK, T.R.
1986: Bed Material Sampling in Gravel-Bed Streams.
IWD-HQ-WRB-SS-86-8.

ABSTRACT

The characteristics of gravel beds are examined to provide insight into the complexities involved in sampling fluvial gravels. A review of the different hand sampling methods and bed material samplers is given to show their respective strengths and weaknesses. Criteria established by various organizations and individual researchers for collecting an adequate sample are assessed, the most rigorous criteria being incorporated in the guidelines. A sampling strategy is proposed with the understanding that further research is required.

RESUME

Les caractéristiques des lits de gravier sont examinées pour mettre en lumière les aspects complexes de l'échantillonnage des graviers fluviaux. Un examen des diverses méthodes d'échantillonnage manuel et des échantillonneuses de matériaux de fond est présenté dans le but de démontrer leurs forces et faiblesses respectives. Sont évalués les critères établis par différents organismes et chercheurs indépendants pour assurer la collecte d'un échantillon approprié; les critères les plus rigoureux sont adoptés dans les lignes directrices. Une approche visant l'échantillonnage est proposée étant entendu qu'une recherche plus poussée est toujours nécessaire.

NORTHWEST HYDRAULIC CONSULTANTS LTD.
1986: The Use and Publication of Hydraulic and Morphologic Data for Canadian Rivers. IWD-HQ-WRB-SS-86-7.

ABSTRACT

The files of the several thousand Water Survey of Canada hydrometric stations in Canada contain hydraulic and morphologic information that is largely unprocessed for publication. An assessment of the potential value of making this information readily available in a published form was the primary purpose of the study summarized herein.

The long development of ideas on the systematic compilation of river data has principally been for scientific purposes. Adaption of these ideas to engineering and environmental studies is outlined. Several case histories are presented in which a Water Survey of Canada gauge was located in close proximity to sites where river hydraulic and morphologic data were collected for specific engineering studies.

A review is made of what baseline data are typically available at a gauge site, and what hydraulic and morphologic information could be extracted and published after perhaps some additional field work. Recommendations are made with respect to how alternative levels of publication effort could be pursued.

RESUME

Les fichiers des milliers de stations hydrométriques de la Division des relevés hydrologiques du Canada contiennent des renseignements en matière d'hydraulique et de morphologie qui sont en grande partie non traités en vue d'une publication. L'étude résumée dans ce document avait principalement pour but d'évaluer dans quelle mesure il serait utile de faciliter l'accès à ces renseignements en les publiant.

La longue évolution des notions inhérentes à la compilation systématique des données relatives aux cours d'eau a surtout visé des buts scientifiques. On expose à grands traits l'adaptation de ces notions à des études de génie et à des études environnementales. On présente plusieurs cas de jauges de la Division des relevés hydrologiques du Canada situées à proximité d'emplacements où des données en matière d'hydraulique et de morphologie étaient collectées en vue d'études spécifiques de génie.

On examine quelles sont les données de base typiquement disponibles à un emplacement de jaugeage et quels renseignements en matière d'hydraulique et de morphologie pourraient être extraits et publiés après, peut-être, exécution de quelques travaux supplémentaires sur le terrain. On formule des recommandations sur la manière de mettre en branle d'autres formes d'activités reliées à la publication.

McLEAN, D.G. and CHURCH, M.
1986: A Re-Examination of Sediment Transport Observations in the Lower Fraser River. IWD-HQ-WRB-SS-86-6.

INTRODUCTION

The main purpose of this report is to present estimates of the annual bedload and suspended load transport rates at Agassiz and Mission. As part of this study, a relatively complete review of the available sediment transport observations was carried out. Particular attention is given to predicting the size distribution of the load and to the problem of distinguishing the wash load and bed material load at each station. The reliability of the available measurements and the precision of the annual load estimates has also been assessed. Some aspects of this work have been published previously (McLean and Tassone, 1985; Mannerström and McLean, 1985).

The first sediment transport measurements on the Fraser River were collected by Johnston (1921) at New Westminster. Later on, a systematic programme of measurements was carried out between 1950 and 1952 at Hope (Kidd, 1953). These data were used by Mathews and Shepard (1962) to estimate the long-term sedimentation rate at the delta. In 1965 Water Survey of Canada began a comprehensive programme to measure the suspended load and bed load at several locations along the main stem and on some tributaries. Since this time bed load and suspended load have been measured periodically at Port Mann, Mission and Agassiz (Figure 1). Only suspended load data have been collected at Hope. Some early results from these measurements were analyzed by Tywoniuk (1972) and by Pretious (1972). More recently the data have been reviewed by Western Canada Hydraulics Laboratories Ltd. (1978) and an overview of the programme was prepared by Kellerhals (1984). However, for the most part, the data have received very little systematic or critical analysis.

DAY, T.J.
1986: Sediment Surveys: It's Time to Yield. IWD-HQ-WRB-SS-86-5.

Introduction

Recent program evaluations have indicated that the Sediment Survey Program of Water Resources Branch must be rationalized and diversified in order to meet the needs of Canadian water resource managers for data, expertise and information.

While sediment is of interest to many Canadian agencies, not one of these appears to have sufficient expertise to address its own concerns, much less provide focus and leadership on a national scale. The proposed new Sediment Survey Program goes beyond mere data collection to give this focus and leadership for sediment and sediment-related concerns in Canada's inland waters.

The proposed changes in the program will result in a network that will continue to be approximately 1/10 of the existing hydrometric network. It will be very specialized, as many aspects of sediment source, transfer and fate (e.g., chemistry, navigation, environmental impacts) must be considered. The program must also pursue its responsibilities to its clients and users agressively and proactively.

ZRYMIAK, P. and CASHMAN, M.A.
1986: Accuracy and Precision in Sediment Surveys: Annotated Bibliography. IWD-HQ-WRB-SS-86-4.

ABSTRACT

This report consists of a compilation of reference material on accuracy and precision relevant to suspended sediment. The reference material pertains to such subjects as sediment erosion processes, sedimentation in reservoirs, lakes and rivers, sediment transport, water quality and water discharge.

RESUME

Ce rapport est un compilation de documents de référence concernant l'exactitude et la précision en matière de sédiments. Ces documents de référence traitent d'une variété de sujets dont les processus d'érosion, la sédimentation dans les réservoirs, les lacs et les rivières, le transport des sédiments, la qualité de l'eau et le débit.

DAY, T.J.
1986: Executive Summaries for Sediment Issues Contracts. IWD-HQ-WRB-SS-86-3.

FOREWORD

This report presents the Executive Summaries for each of the five sediment issue reports prepared under contract for the Sediment Survey Section, Water Resources Branch of Inland Waters Directorate. All reports are in final form.

Prefacing the Executive Summaries are notes prepared for Inland Waters Directorate meetings during which the issue reports were discussed. These notes will provide insight into the Sediment Survey Section's initial assessment and reaction to the issue reports. A copy of the existing mandate for the Sediment Survey Program is also included.

BLANCHFORD, D.P. and DAY, T.J.
1986: Sediments in Water Quality Assessments: Opportunities for Integrating Water Quality and Water Resources Branches Activities. IWD-HQ-WRB-SS-86-2.

EXECUTIVE SUMMARY

Inland Waters/Lands has opportunities for integration of operational activities in addressing the issue of the role of fluvial sediments in environmental quality. These sediments, particular their fine proportions, play a dominant role in the quality of the aquatic environment as they are capable of transporting quantitites of nutrients and contaminants to and within aquatic systems, and of regulating nutrients and contaminant availability to the biological community.

Determining the status of aquatic quality is the primary responsibility of Water Quality Branch. Water quality assessments conducted by the Branch provide data and information regarding aquatic quality. The goals of the assessments are to establish for envionmental impact assessments and to monitor for the development of or compliance with water quality objectives. The Sediment Survey Program of Water Resources Branch provides data on particle size and sediment concentration as well as information on seasonal and spatial variability of suspended sediment in fluvial and lacustrine systems. The goals of the assessment can only be met with the availability of this type of physical sediment data.

The roles of Water Quality and Water Resources Branches can be linked with regards to the procurement and usage of sediment data as part of water quality assessments. Water Resources Branch through its Sediment Survey activities provides expert advice on sediment dynamics, environmental processes and interpretation. A unique and important opportunity exists to address sediment issues be they toxic-related or simply a physical characteristic capable of limiting bioproductivity.

This report identifies opportunities for a new and improved working relationship between the Branches.

BINDA, G.G., DAY, T.J. and SYVITSKI, J.P.M.
1986: Terrestrial Sediment Transport into the Marine Environment of Canada: Annotated Bibliography and Data. IWD-HQ-WRB-SS-86-1.

ABSTRACT

This report consists of a compilation of reference material pertaining to sediment transport into the marine environment of Canada. It is divided into three sections: 1) references and abstracts, 2) tables showing Water Survey of Canada data and data contained in specific studies and 3) a map showing the sites with available data.

RESUME

Ce rapport est un catalogue de références concernant le transport de sédiments à l'environnement marin du Canada. Il est divisé en trois sections: 1) références et résumés, 2) tableaux illustrant les données compilées par la division des relevés hydrologiques du Canada et celles contenues dans des études particulières et 3) une carte indiquant la localisation des sites étudiés.

DAY, T.J.
1986: WNR Sediment Survey Program: Issues, Network and Recommendations. IWD-WNR(A)-WRB-SS-86-2.

INTRODUCTION

The Terms of Reference for the hydrometric network evaluation and planning activities, Appendix I, stated the objectives are to (1) define the adjustments to existing networks and (2) identify additional requirements for streamflow, water level and sediment information in the Western and Northern Region (W&NR).

Initial emphasis was to be given to a definition of the federal responsibility requirements and an evaluation of how well the existing network met those requirements. In addition, the joint federal-provincial and provincial information requirements were to be defined and compared to the ability of existing network to provide that information. Two planning horizons were to be used: 1985 as a definition of present requirements, and 1990 as the near-term future requirements.

As the essence of this review exercise was the establishment of information requirements in W&NR, the evaluation of 'sediment aspects' was based upon the Sediment Survey Program rather than networks only. This distinction is important as this program is delivered through both a 'network' of data collection stations and of studies (e.g. morphological, sediment budgets, relation to ecosystems and water quality).

The information summarized herein was obtained from several sources. First, a questionnaire (Appendix II) was distributed to federal and provincial agencies and a few key individuals (e.g. universities, consulting firms). The questionnaire covered problems, activities, data, information requirements and the guidance required from the Water Resources Branch. Further sources of information were previous program evaluation reports, both regional and national, and from a range of reports which contain either single station or regional data evaluations. Finally, Water Survey of Canada files on data collection programs were used to compile various summary information.

Unfortunately, certain gaps and weaknesses in this information prevented a thorough assessment of the existing program and future needs. Consequently, the Terms of Reference can be met in only a general way. It has been possible only to develop a new sense of direction for the program.

BINDA, G.G. and DAY, T.J.
1986: Sediment-Related Literature for the Western and Northern Region: Annotated Bibliography, 59 p., IWD-WNR(A)-WRB-SS-86-1.

ABSTRACT

This report consists of a compilation of reference material pertaining to sediment in the Western and Northern Region of Inland Waters Directorate, Environment Canada.

It is divided into two sections: 1) references and abstracts and 2) a subject cross-reference index. Subjects cover a wide range of interests such as quality aspects of sediments, erosional processes, sedimentation in reservoirs, lakes and rivers and sediment transport in rivers.

RESUME

Ce rapport est un catalogue de références concernant les sédiments dans la région de l'Ouest et du Nord, Direction des eaux intérieures, Environnement Canada.

Il est divisé en deux sections: 1) références et résumés et 2) un index de renvois par sujet. Les sujets englobent une large gamme d'intérêts tels la qualité des sédiments, les processus d'érosion, la sédimentation dans les réservoirs, les lacs et les rivières et le transport de sédiments dans les rivières.

WASHBURN AND GILLIS ASSOCIATES LTD.
1986: Proceedings of Freshwater Sediment Issues Workshop, June 26, 1986, Charlottetown, P.E.I. IWD-AR-WRB-SS-86-113.

ABSTRACT

On June 26, 1986 a workshop on Freshwater Sediment Issues was held at the University of Prince Edward Island in Charlottetown. The workshop brought together individuals from the four Atlantic provinces who are dealing with problems of the source, transport, fate, and environmental effects of sediment in freshwater. Representatives from university, industry, consulting, provincial government, and the federal government took part in the intensive one-day workshop, which included 22 short presentations followed by four simultaneous working group sessions.

The workshop was jointly funded by the Environment Departments of the four Atlantic provinces and the Water Resources Branch of Environment Canada. The initiative of the Water Resources Branch was instrumental in making the workshop a reality.

The results of the workshop have been condensed into proceedings, which provide, first, the rationale for the workshop and its objectives; second, the proceedings themselves, given in a concise format; and third, a series of recommendations for new directions in sediment programs in the region. Recommendations are given which span the full range of sediment issues. The formation of a Regional Advisory Group is suggested for the coordination of research directions and data collection efforts.

CONSERVATION MANAGEMENT SYSTEMS
1986: Sediment Issues and Data Needs in Ontario, Executive Summary. IWD-OR-WRB-SS-86-2.

EXECUTIVE SUMMARY

In response to a need expressed by Environment Canada, Conservation Management Systems has undertaken a thorough study of sediment issues and programs in Ontario. This study has involved the use of a questionnaire and interviews with a cross section of sediment data users and collectors in the province, a one-day workshop with representatives from many of the sediment data user groups, and an extensive literature review regarding knowledge gleaned from Ontario sediment data. Results from this multifaceted approach to the topic have been combined, organized, and discussed under the headings of: sediment issues, sediment knowledge, and sediment data. The study has led to a clarification of issues relating to sediment, an assessment of knowledge regarding sediment in Ontario, and the identification of needs and recommendations regarding the data base, sampling strategies and methods, and the sediment information system.

CONSERVATION MANAGEMENT SYSTEMS
1986: Sediment Issues and Data Needs in Ontario, Final Report. IWD-OR-WRB-SS-86-1.

ABSTRACT

This report presents results obtained from a study of sediment issues and programs in Ontario and is one of several reviews across Canada to establish a national perspective on sediment issues and related program needs for Environment Canada. The Ontario study involved the use of a questionnaire and interviews with a cross section of sediment data users and collectors in the province, a one-day workshop of data users, and an extensive literature review. Results are combined, organized and discussed under the heading of sediment issues, knowledge, data and information systems. The report identifies needs and makes recommendations regarding the data base, sampling strategies and methods, and the sediment information system.

NOTE: A French translation of the text of this report is available upon request.

RESUME

La présent rapport renferme les résultats d'une étude sur des questions et des programmes relatifs aux sédiments en Ontario. Il s'agit de l'une des nombreuses études menées au Canada pour se doter d'une perspective nationale sur les questions relatives aux sédiments et sur les besoins connexes des programmes d'Environnement Canada. En Ontario, on s'est servi d'un questionnaire et on a mené des entretiens avec un transect d'utilisateurs de données et d'échantillonneurs partout dans la province. On a donné un atelier d'un jour pour les utilisateurs de données et on a fait une revue de littérature exhaustive. Les résultats ont ensuite été compilés, organisés et discutés sous différentes rubriques : questions relatives aux sédiments, connaissances, données et systèmes d'information. Le rapport signale des besoins et renferme des recommandations relativement à la base de données, les stratégies d'échantillonnage et les méthodes connexes, et le système d'information sur les sédiments.

NOTE : On Peut obtenir sur demande la version française du cette rapport.

NORTHWEST HYDRAULIC CONSULTANTS LTD.
1986: Sediment Station Analysis: Saskatchewan River at the Pas, 05KJ001. IWD-WNR(W)-WRB-SS-86-1.

ABSTRACT

This is one in a series of sediment station analysis reports issued by Water Resources Branch, Environment Canada. It presents a summary and analysis of the 1954 to 1984 sediment record of the Saskatchewan River at The Pas. The data and analysis are interpreted in terms of upstream conditions and the changes that have occurred over the record period.

Hydroelectric, storage and irrigation developments in the basin during the record period have altered the flow regime and created sediment sinks. These developments include the construction of Gardiner Dam on the South Saskatchewan River and of Squaw Rapids Dam on the Saskatchewan River, both during the nineteen-sixties, as well as increasing irrigation withdrawals from the South Saskatchewan system. Prior to the Squaw Rapids development and creation of Tobin Lake Reservoir in 1963, the Saskatchewan Delta - Cumberland Lake complex was an area of net sediment deposition. It appears that since 1963 the situation has reversed and that the delta is now an area of net erosion.

It is considered that the available data at The Pas sufficiently describe the present sediment regime, and that the data collection program could well be suspended for a period and then reinstated to check for consistency. This recommendation should, however be discussed with Water Quality Branch. A short-term program is suggested to determine sediment loads in various parts of the delta complex in the Cumberland Lake area. Comments are also made about the Prince Albert station.

RESUME

Il s'agit d'un rapport d'analyse de station de levées sédimentaires dans une série que publie la Direction des ressources en eau d'Environnement Canada. Il renferme un résumé et une analyse des relevés sur les sédiments de la rivière Saskatchewan à The Pas de 1954 à 1984. Les données et l'analyze sont interprétées en fonction des conditions en amont et des changements qui se sont opérés au cours de la période visées par les relevés.

Les travaux d'aménagement hydroélectrique, de constitution de réserves d'eau et d'irrigation dans le bassin au cours de la période visée par les relevés ont modifié le régime d'écoulement et ont créé des bassins de sédiments. Parmi les aménagements, il y a eu la construction du barrage Gardiner sur la riviéere Saskatchewan-Sud et du barrage Squaw Rapids sur la riviéere Saskatchewan-Sud - dans les deux cas, au cours des années 60 - et il y a aussi eu l'augmentation des prélèvements d'eau pour l'irrigation à même le bassin de la Saskatchewan-Sud. Avant la

construction du barrage Squaw Rapids et la création du réservoir Tobin, en 1963, le complexe du delta de la rivièere Saskatchewan et du lac Cumberland était un endroit où il y avait dépôt net de sédiments tandis que tout porte maintenant à croire que depuis 1963, c'est l'inverse que s'est produit et le delta est maintenant un endroit où il y a perte nette de sédiments.

On estime que les données connues à The Pas décrivent avec suffisamment de précision le régime sédimentaire actuel et que le programme de collecte des données pourrait être suspendu pendant un certain temps et repris par la suite afin de vérifier si les données sont constantes. Il faut cependant que cette recommendation soit discutée avec la Direction de la qualité des eaux; on suggère qu'il devrait y avoir un programme à court terme afin de déterminer la charge sédimentaire à divers endroits du complexe du delta dans le secteur du lac Cumberland. Il y a également des observations sur la station de Prince-Albert.

ZRYMIAK, P. and TASSONE, B.
1986: Sediment Station Analysis Fraser River at Hansard 08KA004. IWD-PYR-WRB-SS-86-1.

SUMMARY

The Water Survey of Canada station, Fraser River at Hansard (08KA004), is located near the headquarters of the Fraser River. Hydrometric data is available from 1954 and sediment data is available from 1972.

Sediment sampling at this site was initiated to obtain data for the FRASER RIVER UPSTREAM STORAGE REVIEW REPORT (Fraser River Joint Advisory Board, 1976). The objective was a plan for flood protection and control in the upper Fraser River Basin. Data from this station were used in the Fraser River Upstream Storage Study's - "RIVER REGIME AND SEDIMENT STUDIES" ((Varzeliotis, 1974) section of the report. This section discusses; possible upstream and downstream morphological effects resulting from dam construction and; sedimentation in the reservoir.

A preliminary study was completed and a report produced in 1974 on the effects of the proposed construction. The report concluded that the effect of river aggradation upstream of the reservoir would be negligible, however, downstream of the dam there would be significant changes. Recommendations stated that because of degradation downstream of the dam and sparcity of sediment data, there was a requirement to continue data collection at this station and at the Marguerite station. Another recommendation was to institute more sediment measuring stations on the Fraser River and its tributaries.

The purpose of this station is to review, interpret and present an analysis of the sediment and discharge data collected at Hansard. It contains station, reach and basin descriptions, a discussion on hydrology of the area, tables and summaries of the data collected, the equipment used and the collection procedures. It also contains an analysis and interpretation which deals with, record length, representativenes, sampling strategy, rating curves, particle size data, suspended sediment yield, sediment sources and dissolved solids.

The results of the analysis indicate:
1) the suspended sediment load transported annually can be quantified by (a) load transported seasonally or (b) water discharge data;
2) the strategy of intensive sediment sampling during high flows was effective for sediment load computations;
3) flows during the 12 years sediment sampling period are represenative of the flows during 31 years of record;
4) flow data are independent, random and homgeneous for period of record;
5) no major changes in delivery of flow or sediment have occurred during their periods of record;
6) the bed load in the system is 2.5% of the total load; and,
7) the life expectancy for the proposed reservoir is 1250 years.

The main recommendation of this report is termination of the intensive sediment sampling program at this station. It also recommends:

1) A miscellaneous program to fill in data gaps;
2) A bed material sampling survey of upstream and downstream reaches; and
3) A clean up of the station file.

LAPOINTE, F.
1985: Etude de la variabilités des methodes d'échantillonnage des sediments en suspension pour des concentrations inférieures à 50 mg/L. IWD-HQ-WRB-SS-85-9.

INTRODUCTION

Cette étude a été faite à partir des recommandations du rapport "Etude de la Représentativité de l'Echantillonneur Automatique PWS Basée sur les Données Existantes". Une carence de renseignements concernant la variabilité des méthodes d'échantillonnage avait été constatée. Dans le but d'acquérir ces renseignements, un programme de relevés a été entrepris en Alberta, au printemps 1983. Initialement, l'étude de deux rivières à granulométrie différente avait été envisagée. Malheureusement, les faibles concentrations rencontrées nous ont contraint à n'étudier qu'une seule station, HIGHWOOD RIVER NEAR THE MOUTH (05BL024) et de ne traiter que des concentrations inférieures à 50 mg/L.

CHURCH, M., KELLERHALS, R. and WARD, P.R.
1985: Sediment in the Pacific and Yukon Region: Review and Assessment. IWD-HQ-WRB-SS-85-8.

SUMMARY OF RECOMMENDATIONS[1]

A. Issues with specific engineering and commercial implications.

B. Studies for improved understanding of sediment transport and deposition process, having general engineering implications.

C. Studies of water quality.

D. Development of standard instrumentation and methods.

E. Procedures in the Sediment Survey Programme.

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[1]Recommendations are in order of priority within, but not between, major categories.

HYDROTECH INC.
1985: Etat de connaissance et prospectives sedimentologiques des eaux douces du Québec. IWD-HQ-WRB-SS-85-7.

SOMMAIRE EXECUTIF

Depuis 1968, il y a eu, au Québec, une collection importante de données sédimentologiques qui s'est intensifiée à partir de 1969, avec l'impltation d'un réseau de base sédimentologique, réparti sur plusieurs bassins de cours d'eau. A partir de 1970, le nombre de bassins jaugés diminua graduellement pour cesser d'être opérationnel depuis 1982. Parmi les raisons qui ont entraîné l'abandon des relevés, outre les facteurs coût des opérations et difficultés de prélèvements, il y a le fait que nombre de données étaient mal utilisées ou inutilisées à cause de l'absence de liens entre les programmes de relevés et les besoins des usagers.

WASHBURN AND GILLIS ASSOCIATES LTD.
1985: Freshwater Sediment Data Collection and Use in the Atlantic Provinces. IWD-HQ-WRB-SS-85-6.

EXECUTIVE SUMMARY

This report presents the findings of a study commissioned by the Water Resources Branch, Inland Waters Directorate of Environment Canada, into the collection and use of freshwater sediment data in the Atlantic Provinces. The primary objectives of the study were to acquire a better understanding of the key sediment issues in the Atlantic Provinces and to obtain a more complete recognition of the utility of Environment Canada's freshwater sediment data in addressing the present and future sediment issues of concern.

The study involved detailed discussions with a number of individuals in government, university, consulting and industry who were interested in freshwater sediment data. A standard questionnaire followed up the discussions with selected individuals. Information provided by these individuals was reviewed in detail, in order to identify the issues of concern in the region with respect to freshwater sediment. Recommendations for change to the Environment Canada sediment survey program were then developed in light of the issues of concern and the ability of the program to address those issues.

The existing Environment Canada sediment survey program in the Atlantic Provinces consists mainly of measurements and publication of suspended sediment concentration and loads at 17 hydrometric stations. There are six active stations in New Brunswick; four in Nova Scotia; three in Prince Edward Island; and four in Newfoundland (none of which are in Labrador). Since the sediment survey program was initiated, data have been collected from a number of stations with widely varying drainage basin sizes; some station data are short-term, while the longest period of record for any station is 20 years. The present database of sediment information does not appear to be targeted to any particular group of users in the Atlantic Provinces.

Various sectors throughout the working community of the region may have need for information on freshwater sediments. For the purposes of the present study, the key sectors adopted for categorization of users are government, university, consulting and industry. Although government involvement in freshwater sediment may include research and development of guidelines, governments in the Atlantic Provinces are also involved in regulations dealing with sediment. The federal Fisheries Act, and provincial water course alteration and environmental protection acts and regulations, may influence activities along rivers and streams and may thereby generate needs for sediment information.

Freshwater sediment issues in the Atlantic Provinces were identified through detailed discussions with a number of selected individuals. A list of potential contacts was first generated; then 106 persons were interviewed in detail and their responses recorded. Questionnaires were then sent to 102 persons, and completed questionnaires were returned by 88. The majority of the 106 contact persons (59%) were government employees. Within the government sector, 62% were affiliated with environment departments. An intermediate or high level of interest in the topic of freshwater sediments was expressed by almost all of the 106 persons.

A variety of interesting points were illustrated through the analyses of the results of personal discussions and questionnaire responses. With respect to the awareness and use of freshwater sediment data, it was found that:

- 70% were aware of Environment Canada program;
- 20% in the government sector were not aware of the program;
- about 33% had used the Environment Canada suspended sediment data at some time;
- about 60% need sediment data to evaluate upstream and downstream changes due to a particular activity;
- only seven percent indicated that they needed data for the design of engineering projects.

With respect to the collection and analysis of data, some of the key points found through discussions and questionnaire responses were that:

- the present distribution of suspended sediment stations in the Atlantic Provinces is inadequate, though the reason that it is considered so is variable depending upon the individual;
- there is interest in having other data to complement the suspended sediment data, such as upstream land use information, particle size distribution, chemical constituents, organic fraction, and dissolved load;
- many individuals require sediment information to evaluate erosion from the land;
- there is need for improved communication between government departments regarding the sediment survey program.

Once the freshwater sediment issues of greatest concern in the Atlantic Provinces were targeted, the objective was to identify the sediment processes associated with those issues and the corresponding data requirements. With data requirements known, the present Environment Canada sediment survey program could be evaluated against the data needs, and recommendations for change could be developed.

In order to quantify data requirements, the report provides a series of tables corresponding to nine key areas of activities or impacts in the Atlantic Provinces. Each table identifies potential problems; processes

associated with the problems; and data requirements to evaluate the appropriate processes. The nine key areas discussed are fisheries, forestry, agriculture, mining, construction activities, water supply, hydropower, recreation, and applied research.

Based on the problems and associated data requirements which are particular to the Atlantic Provinces, it appears that the Environment Canada sediment data program, in its present form, provides a limited degree of support to data users. The primary reason is that many individuals require site-specific data for a limited period of time. Another important reason is that the transferability of sediment data (from one basin to another) is an open question to many data users. In addition, the Environment Canada data may be inadequate for those users who require additional data about sediment samples, such as organic fraction, metals content, or presence of contaminants.

It is noted, however, that despite the unknown "value" of the sediment data being collected at present, many individuals feel that sediment data are necessary for understanding the processes and the sediment regime of the region. This opinion was considered important, and it was reflected in the recommendations of the report.

The report provides a series of recommendations. Because the study had the objective of evaluating the Environment Canada sediment program from an outside perspective, the recommendations are broad-ranging, and do not necessarily follow the current program mandate. Recommendations are given in six sub-sections.

NORTHWEST HYDRAULIC CONSULTANT LTD.
1985: Assessment of Sediment Issues and Survey Program in the Prairie Provinces. IWD-HQ-WRB-SS-85-5.

INTRODUCTION

The study is one of a series commissioned in 1984 by the Sediment Survey Section of Water Resources Branch, Environment Canada. It was designed to provide a better understanding of the role and importance of streamborne sediment in the Prairie Provinces and to make recommendations for the future direction of the Sediment Survey program.

CONSERVATION MANAGEMENT SYSTEMS
1985: Ontario Perspectives on Sediment Issues - Phase I, Interim Report. IWD-HQ-WRB-SS-85-4.

INTRODUCTION

Background

This interim report presents preliminary results obtained during the first phase of a study of sediment issues and program review in the Province of Ontario. Conservation Management Systems was retained to undertake the study in response to a wish of Environment Canada, Ontario Region, and the Sediment Survey Section of the Water Resources Branch to acquire a better understanding of the role and importance of sediment data in Ontario. Phase I of the study has focused attention on the identification of existing uses of sediment data, evaluation of the data base, and clarification of issues associated with sediment. The second phase to be undertaken commencing in April 1985, has been planned to assess the state of knowledge regarding sediment and to identify future data needs and approaches to meet those needs. The results emanating from the two phases of this study, when assembled with results from similar studies being undertaken in four other regions of the country (i.e. British Columbia and the Yukon, the Prairies, Quebec, and the Maritimes), are intended to provide a base for the establishment of a national perspective on sediment issues.

Relevance of the Study

It seemed evident at the outset of this study, but has become increasingly clear during Phase I, that the exercise of reviewing the sediment program in Ontario is particularly relevant at this time. The existing data base has been assembled now for upwards of 20 years, a sufficiently long period of record to allow useful analysis and examination of questions such as: What have we learned? Where now? Much has already been done with sediment data in the last few years (e.g. as input to local reservoir and harbour studies, and to regional water quality projects undertaken under the auspices of groups such as the Pollution from Land Use Activities Reference Group, the Grand River Implementation Committee, and the Thames River Implementation Committee), leading to the development of both temporal and spatial pictures of sediment generation and transport. In light of such work, it is appropriate to ask: Where now are the gaps in our information and knowledge?

It has also become evident that whereas sediment data was used 20 years ago primarily for sediment volume related studies, the data is now being examined extremely with regard to quality oriented issues. Further, it is evident that the users of the data are no longer solely engineers but also biologists, agrologists, geographers, farmers, etc. Therefore, it is indeed timely and important to review the issues, users, and uses associated with sediment in the province, and to resolve the questions: Do present sediment data meet our needs? How should sediment programs be modified to insure that most future needs can be addressed?

McLEAN, D.G.
1985: Lower Fraser River Survey 1984: Agassiz-Rosedale Bridge to Mission. IWD-HQ-WRB-SS-85-3.

ABSTRACT

During the summer of 1984 hydrographic surveys were carried out over the 46.5 km of the Lower Fraser River between Mission and the Agassiz-Rosedale Bridge. An Environment Canada crew with the automated HYDAC survey system collected over 400 cross sections along 38.5 km of main channel. UBC crews surveyed 136 cross sections over 10 km of the main channel and 18 km of side channels using conventional hydrographic surveying techniques. Approximately one man-year of effort went into the field work. This work represents the first comprehensive survey in this reach since 1952.

McLEAN, D.G. and MANNERSTROM, M.C.
1985: History of Channel Instability Lower Fraser River: Hope to Mission. IWD-HQ-WRB-SS-85-2.

ABSTRACT

The history of lateral channel instability along the lower Fraser River between Mission and Laidlaw is described. Channel changes over the last century have been documented by preparing a series of large scale channel shift maps. Some of the factors governing past channel instabilities are described. Vertical channel changes were studied by analyzing available data from hydrometric stations and from repeat channel surveys.

CHURCH, M., McLEAN, D.G., MANNERSTROM, M.C. and EVANS, D.
1984: Reference Materials on Sedimentation and Morphology of the Lower Fraser River. IWD-HQ-WRB-SS-85-1.

INTRODUCTION

This report presents a compilation of reference materials on the subjects of physical hydrology, sedimentation, morphology, and related engineering problems on the lower course of Fraser River, British Columbia. The "lower course" of the river is taken to mean the river between Yale and the sea, a distance of some 190 km (114 miles). This includes the entire length of the alluvial channel of the river below Fraser Canyon (cf. figure 1).

Between Yale and Hope (165 km; 99 mi. above the mouth), the river flows in a straight, single channel that is more or less constricted between Pleistocene terraces and, sometimes, bedrock. Below Hope, the river flows through its own floodplain and delta to the sea. Between Wahleach Creek (Laidlaw) and the mouth of Sumas River the channel is braided, and below that follows a single channel to the head of its "modern delta" at Port Mann, near the city of New Westminster. The lowermost 98 km (59 mi.) of the river's course may be subject to tidal influences during at least part of the year but, during the annual spring freshet tidal influence is much more restricted. Salt water is restricted to the lowermost few kilometres of the Douglas Island and corresponds to that part of the river that is substantially affected by tides.

There are several major channels connecting the river with major lakes on the north side of the floodplain, and several more or less insignificant tributaries flowing to the main river on the south side. These channels and their alluvial deposits are included within the purview of the bibliography, though there is relatively little published work to report.

In making decisions about what material to include, criteria were adopted:

1. The report attempts to be exhaustive in the central areas of clastic sedimentation and alluvial morphology. In relevant areas, such as physical hydrology and hydraulics, surficial geology, engineering and hydrological material was excluded--particularly relatively obscure reports that only incidentally contain information that is more explicitly or more readily available elsewhere. The particular subject of transport of dissolved materials has been included by listing major reports and sources of data. The general subjects of water quality and pollution of lower Fraser River waters have not been included, though.

2. The report is restricted to material making specific reference to Fraser River. General reference works are excluded.

3. The report is restricted to material that is publicly accessible. A great deal of valuable information has been gathered in the course of commissioned engineering investigations. In many cases, however, the results remain restricted either by confidentiality or by the simple fact that the reports remain in one or two copies in private hands. Such reports are not listed. Engineering and planning reports prepared for government agencies commonly become accessible for general or specific purposes and these are listed. The appearance of a reference in this report should not, however, be construed to mean that it is casually available.

4. The report does not list projects in progress.

5. References have generally been examined and confirmed by the writers, except as explicitly noted. In cases where the material has not been seen, it is included only if it has been reliably referenced in more than one source.

The bibliography is assuredly not complete. In several places, the existence of unexamined data resources is noted. Beyond that there are two particular areas of weakness:

(a) Historical materials related to the river, particularly photographic materials and local surveys: this material can only be uncovered by extensive search and fortuitous discovery. The work is beyond our resources.

(b) Engineering reports and other privately or irregularly published data. Companies, public agencies and individuals may often be willing to provide access for good purpose to materials that are nevertheless not noted or referenced elsewhere. In such cases, we have no means for systematically tracing materials.

DAY, T.J. and SPITZER, M.
1985: Sediment Station Analysis: Highwood River near the Mouth, 05BL024. IWD-WNR-WRB-SS-85-1.

ABSTRACT

Sediment data were collected at the hydrometric gauging station site, Highwood River near the Mouth, during the period 1970 to 1981 inclusive. The report deals primarily with suspended sediment, but includes information on bed material as well. This report documents the collected data and treats it in various tabular, graphical and statistical ways. It also contains a basin description and photographs taken in the immediate vicinity of the gauging station.

RESUME

Les données sur les sédiments ont été relevées à l'emplacement de la station de jaugeage hydrométrique, Highwood River near the Mouth, pendant la période de 1970 à 1981 inclusivement. Les données concernent principalement les relevés de sédiment en suspension; dans certains cas, des informations sur le charriage de fond peuvent être incluses. Ce présent rapport fournit la documentation au sujet des données sous forme de graphiques, de tableaux, et de statistiques. Il y aussi une description du bassin hydrographique, et des photos de l'emplacement de la station.

LAPOINTE, F.
1983: Etude de la representativité de l'échantillonneur automatique PWS basée sur les données existantes. IWD-HQ-WRB-SS-84-6.

INTRODUCTION

L'utilisation de l'échantillonnage automatique au Canada débute en 1970 avec l'acquisition des modèles américains US-PS67 et SIRCO. En 1972 nous commençons à se servir d'un échantillonneur canadien, le PWS. Depuis sa mise en opération, peu d'études ont été effectuées. Au total il y a eu un rapport sur des essais en laboratoire et deux rapports traitant de son comportement sur le terrain. Le rapport du laboratoire concluait que l'échantillonneur automatique donnait des résultats satisfaisants tandis que les deux autres rapports affirmaient le contraire. Sur le terrain lorsque les conditions étaient mauvaises, les concentrations obtenues par le PWS montraient des variations élevées pour des échantillons pris successivement.

CASHMAN, M.A.
1987: Laboratory Procedures for Sediment Analysis. IWD-HQ-WRB-SS-84-5.

PREFACE

The Water Resources Branch of the Department of Environment is responsible for the national program of collecting, analyzing and disseminating water quantity data and for providing information and advice concerning this aspect of Canada's inland waters. Water quantity or hydrometric data consist mainly of water levels, flows and sediment transport.

Field and Office Manuals are prepared to define and describe standard procedures and practices to be followed by the personnel in the collection, processing, computing and publication of surface water data.

Sediment Manuals are used as basic training aids by Water Survey of Canada technicians who are progressing through their career development program. Standards defined within the manuals reflect the optimum procedures and practices in their time and therefore, cannot be considered static.

PREFACE

La Direction des ressources en eau du ministère de l'Environnement est responsable du programme national de collecte, d'analyse et de diffusion des données sur la quantité des eaux. Elle est également chargée de fournir renseignements et conseils ayant trait à la quantité des eaux intérieures canadiennes. Les données sur la quantité des eaux, ou données hydrométriques, concernent principalement le niveau d'eau, le débit et le transport des sédiments.

Les manuels pratiques et les manuels théoriques servent à définir et à décrire les méthodes et pratiques courantes que doit suivre le personnel de la Direction pour la collecte, le traitement, le calcul et la publication des données sur les eaux de surface.

Quant aux manuels sur les sédiments, ils servent de matériel pédagogique de base aux techniciens de la Division des relevés hydrologiques du Canada qui progressent dans le cadre du Programme de formation professionnelle. Les normes définies dans les manuels traduisent les meilleures méthodes et pratiques disponibles au moment de leur publication et peuvent donc être appelées à changer.

McILHINNEY, J.L. and CASHMAN, M.A.
1984: ODEN Curve Automation Study. IWD-HQ-WRB-SS-84-4.

INTRODUCTION

The bottom withdrawal tube analysis (BWTA) method is one of the standard methods used to analyze the particle size distribution of suspended sediment samples. This method is being used in the four Water Resource branch Sediment Laboratories in Canada and has been used in several Federal Sediment Laboratories in the United States for many years. The BWTA method of particle size analysis is based on the theory of a uniformly dispersed sedimentation system, which was first presented by Oden (1916). The method was later generalized by Fisher and Oden (1923), and summarized with discussions by Oden (1925) and Krubein and Pettijohn (1938).

Direct application of the theory for a given sample of sediment would require uniform particle size distribution, but this distribution in general is not available. Therefore, the graphical approach of the BWTA method is more generally adopted. The application of Oden's theory in the BWTA method results in an accumulation curve, the so-called Oden curve. This curve has time as the abscissa axis and percentage by weight of the total material settled out in a fixed column of 100 cm as the ordinate (Figure 1). A tangent is drawn from the Oden curve at a specific time, determined by a selected particle size at a given temperature, to intercept on the ordinate. This point of interception represents the corresponding "percent finer" of the selected particle. However, the range of time covering the settlement of the sediment is so large and the measured points are so unevenly distributed along the time scale that it is difficult to draw a continuous curve with an acceptable accuracy on rectangular coordinate paper. To overcome this difficulty, the curve is broken up into segments (Figure 2) with overlapping between two adjacent segments (Report No. 7, The Inter-Agency Committee on Water, 1943). The average of two tangents is taken when a selected particle size is located in the end portions of two overlapping time segments.

The division of a continuous Oden curve into segments in some cases, has been found to cause discrepancies with the correct curve. For example, in the manual computations the larger scale makes it particularly difficult to accurately draw the right portions of curve C and curve D (Report No. 10, The Inter-Agency Committee on Water, 1953).

Automating the BWTA procedure would save a considerable amount of time over the manual computations and procedures. Also, it would provide better quality control as results would always be the same for a particular set of data. Due to human interpretation it is possible to get different results from the same set of data computed manually.

KELLERHALS ENGINEERING SERVICES LTD.
1984: Review of Sediment Survey Program, Lower Fraser River, British Columbia. IWD-HQ-WRB-SS-84-3.

INTRODUCTION

1.1 The Fraser River

The Fraser River originates in the Rocky Mountains some 30 km southwest of Jasper and drains 233,000 km^2 of south-central and south-western British Columbia to the Straight of Georgia. The term "Lower Fraser River" generally refers either to the lowermost 190 km navigable reach of the river from Yale (at the mouth of the Fraser Canyon) to Sand Heads (a navigation light at the outer edge of the delta) or to the somewhat shorter (165 km) alluvial reach from Hope to Sand Heads. This latter reach corresponds to the present study area.

Continuous flow and sediment transport data are available for four sites along the lower Fraser, although occasional data have been obtained elsewhere (Zyrmiak, 1982; Church et al., 1984). The four sites, with the corresponding distances from Sand Heads along the thalweg, are Hope - km 165, Agassiz - km 130, Mission - km 84, and Port Mann - km 43. A detailed discussion of data available in 1984 is presented subsequently in Section 2.

The runoff regime of the Fraser River at Hope is snowmelt dominated. Over the seventy-one years of continuous flow records at Hope, annual peaks have ranged from 5130 m^3/s to 15,600 m^3/s, with a mean of 9600 m^3/s, and have occurred between May 1 and July 16.

The annual low flows range from 340 m^3/s to around 900 m^3/s and occur between late November and early April. Mean annual runoff is 86.2 X 10^6 dm^3 over the period of record. Runoff for the period 1952 to 1982 is significantly greater than for the previous 30 years, and this in spite of a major diversion of flow out of the Fraser drainage (see below).

The lowermost 20,000 km^2 of the Fraser drainage area is subject to very intense autumn and early winter rainstorms due to large-scale frontal disturbances moving eastward from the Pacific and rising over the Coast and Cascade Mountains. The storm of December 26, 1980 is a good example of this situation. At Hope, flows reached 4210 m^3/s on December 27, 1980, well below the annual peak of 6170 m^3/s of June 22nd. The drainage area increase from Hope to Mission amounts to only 5 percent.

The extent of the tidal reach of the Fraser varies with flow. At low flows it reaches to Sumas Mountain at km 95, but with Hope flows exceeding 5000 m^3/s tidal effects at Mission become very small. Flows

reverse at Port Mann until the flow at Hope exceeds 4000 m^3/s (Ages and Woollard, 1978). Salt water from the Straight of Georgia can intrude some distance into the Fraser estuary, depending on flow and tide range. With low Hope flows and large tides the salt wedge may reach New Westminster (km 35), but under freshet conditions it rarely extends beyond the Steveston Bend, km 10 (Beak, 1981).

Morphologically the lower Fraser can be divided into three distinct reaches. From Hope to Sumas Mountain the river is a wandering, split and unstable gravel-bed channel, frequently confined by bedrock spurs and by rip-rap-protected embankments. Confinement decreases below Hope as the valley widens. At km 95 there is an abrupt transition to a single, sinuous channel with a sand bed, frequently confined by pleistocene uplands. The delta reach starts at New Westminster, where the river splits into three distributaries.

The Fraser River has large commercial and recreational fish resources, primarily based on the five species of Pacific Salmon. Almost the entire main stem and most significant tributaries are utilized by salmon and this is the primary reason why the river remains essentially unregulated.

Only two tributaries of the Fraser River above Hope are significantly affected by regulation. The Nechako River above Kenney Dam would contribute some 8.5 percent to the flows at Hope (See Table 1.1). Of this, some 108 m^3/s or 4.6 percent of the Hope flows are diverted out of the Fraser drainage and 91.3 m^3/s or 3.9 percent are returned to the Fraser in a regulated manner, but a further 50 m^3/s may be diverted within the next 5 to 10 years. regulation of the Bridge River affects 4.3 percent of the Hope flows. Several tributaries to the tidal reach below Mission, the Stave, Alouette and Coquitlam Rivers are also regulated (Beak, 1981).

Over 1 million people live within a few kilometres of the lower Fraser River and the lowermost 37 km are navigable for oceangoing vessels. The remainder of the study reach is also navigable but is primarily used for towing logs, barging forest products, gravel and quarried rock, fishing and pleasure. Maintenance of the navigation channel is an ongoing problem. Below Port Mann, annual dredging is required. Several million cubic metres of sand are moved each year. The gravel-bed channel above Sumas Mountain also requires some maintenance in order to remain navigable.

The lower Fraser has a floodplain of some 82,000 ha, most of which is developed and protected from flooding by an extensive system of dikes, drainage canals and pump stations. The large freshet of 1948 flooded some 25,000 ha of developed land (Fraser River Joint Advisory Board, 1976).

ADAMOWSKI, K.
1984: Statistical Analysis of Sediment Data Records. IWD-HQ-WRB-SS-84-2.

SUMMARY

The purpose of this report is to provide and discuss several statistical analyses of sediment data. Time series analysis, frequency analysis, and information content were investigated on three series of daily concentrations of different lengths.

The time series analysis of the monthly means revealed much periodicities in the sediment concentrations, especially for the two stations from Alberta where it accounted for seventy-seven and ninety-one percent of the variance of the series. Similarly, there were high periodicities in the daily data. There was no indication of trends in any of the three available series.

With daily sediment concentrations, their monthly means, as well as their annual means when possible, distributions were fitted to the three records. The usual distributions could not fit the daily data and the lognormal fitted the monthly means of the station from New Brunswick. The normal distribution fitted the annual means of that same record, while the lognormal will likely fit the other two, which are from Alberta. These two stations from Alberta were much more skewed than that from New Brunswick.

The variation of the information content throughout the year as well as the sample lengths required for a given degree of accuracy were determined. The monthly relative information content indicated that at the two stations from Alberta, because of the large seasonal variations in sediment concentrations, sampling could be reduced or even discontinued at certain times of the year, usually corresponding to winter months.

Because the annual means of these two highly skewed stations will likely be lognormally distributed, to which will correspond a high coefficient of variation, the required sample lengths for a ten percent accuracy in the mean with ninety-five percent confidence are enormous. Similarly, for the median, the sample lengths are also very large. At the New Brunswick station, however, only nine additional years of sampling are required to reach a ten percent accuracy in the mean with ninety-five percent confidence.

YUZYK, T.R.
1984: Reservoir Sedimentation Studies in Canada.
IWD-HQ-WRB-SS-84-1.

INTRODUCTION

This report was prepared for the following purposes:

- to review knowledge of reservoir sedimentation;
- to present methods to evaluate reservoir sedimentation;
- to compile and document findings from Canadian case studies;
- to make recommendations for further research and studies.

YUZYK, T.R.
1983: Lake Diefenbaker, Saskatchewan: A Case Study of Reservoir Sedimentation.

EXECUTIVE SUMMARY

In 1965 a field survey program was implemented to monitor general sedimentation patterns, delta formation and bank erosion in what was to become Lake Diefenbaker. The program consisted of establishing 38 range lines (cross sections), spaced so that they would be representative of changes and surveying them on a regular basis. A sampling program was included to collect information on suspended sediment, bed material and water temperatures. The field programs were conducted jointly by the Sediment Survey Section (Ottawa), Water Survey of Canada (Regina) of Environment Canada and the Hydrology Division, Saskatchewan Environment.

After fifteen years of data collection it was agreed that this program should be reviewed. The review focussed on two principal areas:

1. To compile, analyze and interpret all the data collected from Lake Diefenbaker and document the sedimentation patterns;

2. To evaluate the existing data collection program and identify changes required to ensure an effective and efficient program.

Sedimentation has not significantly affected the reservoir operation, since only 1.4% of the total reservoir capacity has been lost between 1966-1980. The area where sedimentation is significant is in the drawdown reach, which lost 19% of its volume, or a 1% loss in live storage. Bank erosion and slumping are active and estimated to have accounted for the other 0.5% of the total 1.5% loss in live storage. The dead storage was computed to have been reduced by 1.3% over this period.

Delta formation was determined to be affected by a low original bed slope, large water level drawdown and reduced sediment loadings in the latter years. The bed slopes indicate that the delta structure has yet to reach equilibrium.

Bed material sampling showed that deposited densities were considerably lower than empirically derived values, which greatly affected the deposited load estimates. Based on the sampling findings, a good agreement between station derived loads and the calculated deposited loads was obtained.

The following recommendations are made based on the findings of this report:

1. This joint program should continue, for it is providing a worthwhile contribution to understanding delta formation and

reservoir sedimentation in the prairies. The information is proving to be not only of site specific importance, but transferable to other reservoir studies. It also provides the opportunity to train and to build upon the expertise already acquired in undertaking sedimentation studies.

2. Due to the low sedimentation rate, the survey interval should be extended from three years to at least five years, the five year interval will insure continuity between surveys. Since most of the deposition is occurring upstream of the Saskatchewan Landing Bridge, and should likely be the case for quite some time, only those upstream ranges should be resurveyed in the future. Special area studies (Elbow, Swift Current Creek Delta) do not have to be resurveyed as they show negligible sedimentation.

3. Certain data collection methodologies (HYDAC-200 data, cross section vs. area method of surveying) need to be further evaluated and more comprehensive guidelines established for sampling (bed material, suspended sediment) in reservoirs.

4. Since the existing range data were not the most suitable data for evaluating the bank contribution; and since bank erosion and slumping are active, an alternative study using either terrestrial photogrammetry or concentrated cross-sectional work should be considered.

5. Numerical modelling of sediment deposition (such as HEC-6, MOBED) was not in the scope of this report, but it should be considered the next logical step. If undertaken prior to the next survey it may help further streamline the program.

KELLERHALS, R., ABRAHAMS, A.D. and VON GAZA, H.
1974: Possibilities for Using Suspended Sediment Rating Curves in the Canadian Sediment Survey Program.

ABSTRACT

Sediment rating equations for predicting mean daily suspended sediment concentration and load from the corresponding water discharge have been developed for five river sites in Alberta and in western Saskatchewan for which four to nine years of daily suspended sediment data are available. The technique used to fit rating equations to the data is stepwise multiple linear regression which is applied to log-transformed data. At most sites only mean daily discharge (Q) makes a significant contribution towards explaining mean daily concentration (C), and the contributions of discharge-related variables, such as "rate of change of discharge" or "time from spring rise" are generally negligible. The residuals of the regression are serially correlated to such a degree that the significance tests normally applied to regressions are meaningless. Plots of the residuals show that the rating equations give poor predictions of C, both during the spring rise in Q and whenever major rainstorms occur on the plains portion of the river basins. A preliminary attempt to improve prediction during major rainstorms by including regionally averaged precipitation into the rating equations was unsuccessful. By themselves, rating equations or curves do not give a satisfactory representation of suspended sediment data, because they fail to represent properly the expected distribution of C. Rating equations based on log-transformed daily data also tend to underestimate long-term sediment yields. Monthly and yearly rating curves can, however, be used for this purpose. A considerable number of other studies concerning rating curves are reviewed and the findings of the present study are shown to be in general agreement.

The objectives of the Sediment Survey program are stated in a form which differs somewhat from the official published version, but which is essentially equivalent. The degree to which the present survey program meets these objectives is then discussed and some suggestions are made on how a survey program based on the extensive use of rating equations could permit a closer approach to the objectives.